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Bernard J. Shapiro, Deputy Minister

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Curriculum Guideline

Technological Studies

Intermediate and Senior Divisions

Part B

2. Construction Grouping

Module 1, 1986

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Introduction to the Construction Grouping

The technological studies curriculum guideline consists of three parts: *Part A: Policy for Program Planning*, Part B, which is structured into ten subject groupings, and *Part C: Ontario Academic Courses (OACs)*. Part A provides essential background for the planning of all courses in technological studies. The following three sections in Part A are especially important in this regard: ''The Aims of Technological Studies'', ''Program Requirements'', and ''Course Planning at the Department Level'' (including the evaluation of both student achievement and the program). The ten subject groupings of Part B are listed in the Appendix of this document, along with the individual subjects and authorized courses. Each subject grouping in Part B is to be treated as a separate component.

Subject grouping
This document is designated as Module 1 for the construction grouping. The grouping includes seven subjects: woodwork; masonry and trowel trades; heating, refrigeration, and air conditioning; plumbing and pipefitting; building and equipment maintenance; custodial services; and painting and decorating.

Students may enrol in courses derived from this document for a variety of reasons. For most students, the courses will be their initial introduction to the occupational areas within the construction grouping. For some, enrolment will be the first step towards an apprenticeship as a plumber. For others, it will be an introduction to other occupations related to the industry, such as carpenter or painter. For many, it will lead to postsecondary studies. While each of the seven subjects outlined in this document deals with unique content, each also involves basic concepts that are common to the subject grouping. For career-planning purposes, students taking courses in any of these seven subjects should gain some insight into the other subjects.

Subject sections
Separate sections are provided in each subject for planning basic, general, and/or advanced level courses. Each section includes aims and suggestions to assist teachers with course planning. Courses must include the skills and knowledge outlined as core content for each section. This core content is identified in chart form. All of the core content indicated for a particular level of difficulty must be included, either in one course or in the sequence of courses for the division.

Although in many cases the core content for the different grades and levels of difficulty is derived from the same units, the depth and breadth of treatment of this content material will vary according to the grade and level of the course. It is expected that the content will be developed to a depth that is appropriate to each level of difficulty and that teaching strategies, projects, and evaluation methods will reflect both the level of difficulty and the grade for which the course is planned.

Course objectives
All courses will be planned to achieve specific learning objectives, which shall be based on the aims for courses at the basic, general, and advanced levels. The nature of the core aims is such that teachers can set learning objectives for each aim according to the grade and ability of the students. The depth and breadth of students' knowledge and skill competence, with respect to the core learning, will increase through successive courses.

Together, the aims, learning objectives, and core content constitute the essential learning for a course. Any remaining course time can be structured to amplify the core learning and/or enrich the course with optional content. Additional topics that are appropriate to particular objectives and course themes may be selected from the section entitled ''Course Content for the Construction Grouping'', at the end of this module, or from the course content listed at the end of any other module in Part B.

Course content (charts)
Charts are used to specify the core content, by division and level of difficulty, for each subject in the construction grouping. The content units listed on the charts correspond to the numbered items listed in ''Course Content for the Construction Grouping''. The letters *a, b, c,* and so on represent subunits of the content units.

Chart 2.1.12 provides a summary of the core content for all courses in the construction grouping. This summary chart serves as a convenient means of identifying what should be taught, comparing core content requirements for different levels of difficulty in a subject, and identifying content that subjects have in common.

Program and course planning
The total time of the course or sequence of courses offered in a subject at any particular level of difficulty over the two-year period of Grades 9 and 10 or Grades 11 and 12 must be a minimum of 55 hours. Where the total time available to the courses in the two-year period exceeds 110 hours, additional content will have to be included to supplement the core learning. The additional topics that are selected must support the course objectives. These topics may be selected from units listed in ''Course Content for the Construction Grouping''. Topics appropriate to particular course themes may also be selected from the content for related subject groupings. For example, content from the general horticulture section in the horticulture component may be incorporated into the masonry and trowel trades program if construction of a masonry flower box is an appropriate project for a particular theme.

Where schools offer courses in two or more subjects of this grouping, there is a need to structure the courses to avoid significant overlaps in course content. Although two such courses may mutually reinforce basic concepts in construction, the types of materials, equipment, and shop challenges that students experience in each course should reflect applications commonly associated with the particular subject field. The student who successfully completes courses in two subjects of this grouping should have an increased awareness of the types of occupational activities, working materials, and equipment associated with each subject as well as a feeling for the relationship between the subjects and for future trends in the field.

Bi-level and bi-grade classes
Classes that combine groups of students taking courses at different levels of difficulty (e.g., Grade 9 woodwork, general and advanced levels) or at different grade levels (e.g., custodial services, Grades 11 and 12) are likely to become more common. Although the teaching strategies and techniques for assessing student progress in bi-level and bi-grade classes may present some special challenges to the teacher, the extra effort is worthwhile: by combining classes, schools can offer courses that would otherwise be impractical because of small enrolments.

Teaching strategies that work well in bi-level classes recognize the fundamental differences in course requirements for students at the two levels. Common lessons should be concise and focus on practical aspects of the subject. Practical assignments should lead to independent studies that develop knowledge and skill at the appropriate level of difficulty. Supplementary lessons should be short, should have different emphases for the two levels, and should lead to practical activities that are different for the two groups. Successful strategies involve students in self-directed work and research projects of a limited length. Group activity in a simulated work environment can both reinforce subject content and develop social skills such as co-operation and responsibility.

Evaluation
Courses based on this module are to a large extent skills oriented. As students acquire skills, they are motivated to acquire related knowledge and develop desirable attitudes and understanding. The skills are reflected in the performance objectives set by the teacher when planning the course. It is against these performance objectives (which set the expected standards of achievement for the particular grade and level of difficulty of the course) that student achievement is measured.

Evaluation of student achievement in skill development involves assessment of both the process and the product of the skill. Checklists are commonly used to identify the operational steps of the process, whether it is building a brick wall or producing a woodworking project. Significant aspects of the completed product or service are identified and commonly assessed with rating scales. When the checklists and rating scales are available to students, they can use them for self-evaluation as they strive for acceptable standards of competence. Comparisons of the teacher's evaluation of a skill and the student's self-evaluation can often clarify the standards that are expected. Performance tests are a valid and effective method for assessing the achievement of a skill.

The success students have in acquiring theoretical knowledge and understanding in construction courses can be assessed through tests and examinations. A variety of assessment techniques, including short oral tests, objective tests (e.g., true-false and multiple-choice), short-answer completion, and regular question-and-answer tests, should be applied in the evaluation process. Written tests should be designed to suit the reading and writing levels of the students. The vocabulary used in the test questions should reflect that used in the classroom. Although students should be encouraged to write answers in proper sentence form, questions and answers that involve diagrams are effective assessment instruments in technological studies.

The development of desirable attitudes and the ability to combine skill and knowledge successfully in practical work tasks are demonstrated by students in their planning and implementation of projects, work assignments, and problem-solving activities. Teacher observation of the student's achievement on such assignments is a valid technique for assessing progress in these areas.

Additional comments about the evaluation of student achievement and some suggestions related to the evaluation of programs in technological studies are outlined on page 24 of *Technological Studies, Part A: Policy for Program Planning*.

Computer software

As computers and appropriate software become available to schools, opportunities for students to successfully accomplish independent study activities will increase. The confidence gained from these experiences is particularly important to today's young people, who face a working life characterized by changing technology and the need to continually update their skills and knowledge.

The effective use of computer programs as learning tools in the classroom can require adjustments in teaching strategies. Students continue to need hands-on experiences with the materials, tools, and equipment associated with courses in this grouping, but computer programs applied at appropriate times can help the teacher to teach, reinforce, review, and test the associated learning.

Students should have opportunities to become aware of the various tasks that computer technology performs in the construction industry. Visits to construction engineering establishments, mechanical contracting firms, and institutional training centres related to the industry can provide insights into the use of computer technology in accessing, recording, and processing information. Students should observe computer assistance in such activities as drafting, estimating the cost of projects, accessing sources of supply, controlling inventory, scheduling operations, and communicating.

Woodwork
Intermediate Division (Grades 9 and 10)

Students may enrol in woodwork courses for a variety of reasons. Most of those who enrol want to acquire knowledge about woodwork or carpentry (building construction) and such skills as the safe and effective use of hand and power tools. Many study woodworking as a means to career goals; others want to put woodworking to personal use, in home maintenance or leisure activities.

For students who leave school prior to graduation, the skills learned in a wood shop may be sufficient preparation for a job on a construction site or in a plant that produces wood products. Many of the skills and work habits acquired in a wood shop are transferable to other technical areas in industry and can be of some assistance to students seeking semi-skilled positions.

Students who continue with Senior Division courses in this subject field may plan on a program of postsecondary studies in a community college, a faculty of engineering, or a school of architecture. A wide range of challenging opportunities related to the construction field exists for students who graduate from one of these postsecondary institutions. Some of the careers available to postsecondary graduates are estimator, construction technician or technologist, interior designer, civil engineer, and architect.

Courses in woodwork are authorized for Grades 9 and 10 at basic, general, and advanced levels of difficulty. Chart 2.1.1 identifies the core content for these levels. The aims and suggestions for designing courses at these levels are provided in the sections that follow the chart.

The amount of in-school time allotted for Intermediate Division woodwork courses may vary, depending on local requirements, from a minimum of approximately 55 hours over a two-year period to a maximum of 220 hours per year. If only the minimum time is available, then some of the core content will necessarily be given superficial treatment. It is suggested that fuller treatment be given to those core items related to safety, layout, woodworking trades materials, foundations, joining and fastening wood, and finishing.

Chart 2.1.1
Core Content for Woodwork
Intermediate Division (Grades 9 and 10)

Content Units	Core Content for Courses	
	Basic	*General / Advanced*
1. Introduction	ab	abde
2. Safety	abi	abi
3. Project management	a	abc
4. Layout	ab	abc
5. Woodworking trades materials	a	ab
8. Foundations	bce	bcde
9. Floor and ceiling construction	e	abcefh
10. Wall construction	c	acd
11. Roof construction	a	abf
12. Wall and ceiling finishing		g
13. Floor finishes		d
18. Insulating	a	ac
19. Truing rough lumber by hand	b	ab
20. Truing rough lumber by machine	ace	abcdef

Content Units	Core Content for Courses	
	Basic	*General / Advanced*
21. Special machines	a	a
22. Joining and fastening wood	b	abd
23. Finishing	a	ac

See ''Course Content for the Construction Grouping'', beginning on page 52, for description of the subunits a, b, c, etc.

Basic Level

Course codes assigned to basic level courses planned under this section will be TCW1B for Grade 9 and TCW2B for Grade 10.

Aims

In all courses based on this section, students will have the opportunity to:

- select and use properly the hand and machine tools required to perform the layout, cutting, fitting, and assembly operations for a woodwork project;
- raise their confidence and self-esteem by successfully completing a woodwork project;
- develop the ability to follow instructions and express ideas clearly;
- protect the safety of the individual and the group by developing safe work habits;
- develop socially acceptable attitudes, including readiness to co-operate;
- learn to accept the decisions of the majority while respecting the rights and opinions of minorities;
- acquire respect for the dignity of honest labour and a sense of pride and achievement in a job well done;
- acquire knowledge of the employment opportunities and skill and training requirements for the various trades and specialized operations associated with woodwork and the construction industry.

Suggestions for Teachers

The content units for woodwork courses at the basic level in Grades 9 and 10 are identified in chart 2.1.1. The topics that constitute these units may be incorporated into the course in various ways to accomplish various objectives. For instance, although unit 1 (''Introduction'') can be presented in its entirety at the beginning of the course, the topics are more meaningful if they are discussed informally whenever appropriate occasions arise.

In dealing with unit 2 (''Safety''), teachers should introduce safety rules related to specific operations, machines, and situations when the appropriate circumstances arise. The teacher must ensure that only students with the necessary maturity are allowed to operate powered equipment. General shop safety should be stressed from the beginning of a course. As the course proceeds, students should gain an appreciation for the overall safety of the individual and the group and express it in safe work habits and attitudes. The importance of the Construction Safety Association and the Industrial Accident Prevention Association should be stressed. Safety films and posters produced by the accident prevention associations may be used to increase student awareness of safety.

Activities associated with unit 3(a) (''Project management'') involve interpretation of simple plans for construction projects. Discussion should focus on how such plans are used to implement the projects and should introduce students to the concept of scheduling.

The topics in unit 5 (''Woodworking trades materials'') should be incorporated into project activities whenever students are likely to

encounter problems related to wood structure (e.g., when they need to choose table leg material with no serious structural defects or to glue narrow stock to make a table top).

When planning basic level courses, teachers should select themes that further the program aims and help students learn the core content. The themes may relate to one of the three woodwork specialties of cabinetmaking, patternmaking, and carpentry or to some combination of them. In Grade 10 basic level courses, the theme may be job opportunities in the industry and may focus on local requirements. Employment conditions vary over time and from region to region. To keep in touch with current practices, teachers should maintain close contact with the industry through service clubs, trade magazines, field trips, and the study of particular areas of the wood construction industry on professional development days.

Themes can generally be structured most effectively around project work. Projects for Grade 9 basic level courses should be interesting, attractive, and simple enough to be completed by the average student in the allotted time. Students are often more interested if they can suggest projects and contribute design ideas. In general, a Grade 9 project should be one that the student can either use or recognize as useful from his or her youthful perspective. Typical woodwork projects in Grade 9 are rustic coffee or end tables, shelving units, stereo stands, speaker enclosures, and storage chests. If time is limited, a smaller project should be considered, such as a spice rack.

Grade 10 carpentry themes can include the design and construction of larger projects. Garden tool sheds, garages, and small sleeping cabins make excellent projects for small groups of students. Students should be encouraged to include the appearance of the structure in their planning. Models are useful, but full-size structures are more interesting and encourage student learning and involvement. Other projects related to commercial or industrial carpentry practices can also be used effectively. These projects should be designed to expose students to core content that was not presented in the Grade 9 course.

So that students may acquire experience on the job site, larger carpentry projects may be prefabricated in the shop and erected on the site. Field trips to various construction sites may also be timed to coincide with the type and stage of construction of the project being built in the shop.

In Grade 10, projects associated with cabinetmaking themes should reinforce and extend the core content covered in Grade 9 introductory courses. More difficult or comprehensive projects should be developed, with greater student involvement at the design stage. Teachers should set realistic limits on project designs while allowing enough freedom to ensure student interest in the completion of the project. To capture the interest of some students, projects could include the design and fabrication of games and sports equipment. Field trips to furniture manufacturing plants, furniture stores, and exhibitions can provide students with useful background information to support cabinetmaking themes.

Woodworking skills and knowledge are also applied in patternmaking, a woodwork specialty normally associated with manufacturing. Projects that relate to a patternmaking theme in Grade 10 must emphasize the basic concepts of patternmaking and foundry work. Optional topics can be selected from the manufacturing subject grouping. Every attempt should be made to illustrate the relationship and importance of the patternmaking process to the foundry and casting process as a whole. Students can learn about the moulding and casting processes of patternmaking by trying them out. Projects can include fabricating precast concrete forms or producing interesting moulds that can be poured to produce plaster-of-Paris objects. The objects can be incorporated in a display at the school and shown at an open house to enhance student pride and motivation.

In general, learning experiences planned for basic level courses should be closely connected to the real world. Abstract concepts and information taught in isolation or with little direct connection to the students' world outside the classroom are of little permanent value to most students enrolled in basic level courses.

For effective learning, skills and knowledge should be closely related to what the students require for completion of their current project or theme activity and should be perceived by the student as having value in the world outside the classroom.

General Level

Course codes assigned to general level courses planned under this section will be TCW1G for Grade 9 and TCW2G for Grade 10.

Aims

In all courses based on this section, students will have the opportunity to:

- organize, schedule, and draw up a basic bill of materials for a simple woodwork project;
- select and use properly the hand and machine tools required to perform layout, cutting, fitting, and assembly operations on a project;
- identify and construct wood joints as required for a project and give reasons for the choice of each joint;
- analyse the needs of a project and choose all materials (including all joining and finishing materials) accordingly;
- complete a project in one of the following woodwork specialty areas: carpentry, cabinetmaking, or patternmaking;
- understand the role of woodworking courses as means of achieving short- and long-term personal goals;
- develop a sense of pride in acquiring a broad range of technical skills and knowledge applicable in the labour market;
- accept personal responsibility as a member of the course relative to work habits, care of equipment, economical use of materials, and respect for the achievement of others;
- protect the safety of the individual and the group by developing safe work habits;
- acquire knowledge of the employment opportunities and training and entry requirements for the occupations associated with woodwork and the construction industry in general.

Suggestions for Teachers

Teachers planning courses at the general level of difficulty should review the suggestions for teachers outlined in the preceding section for the basic level. In courses planned for the general level of difficulty, students can be expected to incorporate theoretical concepts of woodworking into their practical assignments. In assessing student progress at this level of difficulty, it is important that the practical aspect of the student's work be emphasized. Approximately 60 to 70 per cent of the student's final mark should be based on practical assignments, such as projects.

It it important that students understand the conceptual content of unit 19. Familiarity with the parts of hand tools is not as important as skill in the use of the tools.

Safety is of prime importance in learning experiences related to the use of machines. By starting the students off with safe techniques, teachers can avoid the need to constantly emphasize ''don'ts''. Students will then learn the safe way and will not be tempted to try something just because the teacher said not to. Memorization of parts and of safety rules that do not relate to the operation being performed should be minimized.

Finished models or projects that incorporate individual wood joints or fasteners are useful items that can be used to generate interest in and discussion of various methods of joining and fastening woods.

Teacher demonstrations of activities will convey the information in the most meaningful way. Remedial work may be guided by videotapes, slide presentations, or information sheets.

All the core units in woodworking are related to three specialty subjects: carpentry, cabinetmaking, and patternmaking. First-year courses will probably be very similar to one another except for the optional units and topics chosen by each teacher. The optional content will vary according to the theme(s) it must enhance.

Second-year courses can support the core content by using themes related to the specialty of carpentry, cabinetmaking, or patternmaking. The optional content in such cases should be chosen to support both the core content and the subject specialty for which the course is designed.

A carefully chosen course theme can help students to achieve the program's aims and to learn the core content. Since the program's objectives are to be achieved by the end of the Intermediate Division, the themes can be designed either to offer specialization in one of the three subject areas or to integrate the areas.

Major projects can serve as useful themes for courses in any of the woodwork subjects. Interesting and attractive teacher-designed projects can be selected for Grade 9 courses. Teachers can enhance students' interest by soliciting their project suggestions and design ideas. Every project should be designed to incorporate some or all of the core content. Optional topics, if necessary to complete the project, may be selected from the course content for the construction grouping (listed at the end of this module). The optional knowledge and skill topics in any course should be chosen to fit the theme. Extra topics that do not relate to the theme should be discarded or used with a new theme. In all cases, the projects selected for a course must reflect both the level of difficulty and the grade at which the course is offered.

Carpentry themes. Grade 10 themes can include the design and construction of larger projects. Garden tool sheds or small sleeping cabins make excellent projects for small groups of students, especially if some imaginative design ideas are used to enhance the appearance of the structures. Models are useful, but full-size structures are more interesting and encourage student learning and involvement. Projects related to commercial or industrial carpentry practices can also be used effectively. These projects should be designed to expose students to core content that was not presented in the Grade 9 course.

Cabinetmaking themes. Cabinetmaking courses in Grade 10 should involve projects that require a higher level of knowledge and skill development than do Grade 9 introductory courses. More difficult or comprehensive project designs should be developed, with greater student involvement at the design stage. Teachers should set realistic limits on project designs while allowing enough freedom to ensure student interest in the completion of the project.

Patternmaking themes. Although woodwork courses normally lead to trades in the construction industry, woodworking skills and knowledge can be applied to patternmaking, a specialty that is normally identified with manufacturing. Second-year patternmaking projects must emphasize the basic concepts of patternmaking and foundry work. Optional topics can be selected from the manufacturing subject grouping. Every attempt should be made to illustrate the relationship and importance of the patternmaking process to the total foundry and casting process. Students can learn about the moulding and casting processes of patternmaking by completing projects that involve these processes.

Advanced Level

Course codes assigned to advanced level courses will be TCW1A for Grade 9 and TCW2A for Grade 10.

Aims

In all courses based on this section, students will have the opportunity to:

- design and execute a woodworking project requiring a variety of machining and hand-tool skills;
- interpret the blueprint of a wood product in order to prepare the list of required materials and their estimated costs;
- acquire general knowledge about a variety of soft and hard woods;
- develop skills in the safe and efficient use of a wide variety of common and specialized hand and power tools;
- relate mathematical and scientific principles to the technology of the woodworking field;
- acquire and improve skills in researching and communicating technological ideas and information through written reports and oral presentations;
- acquire an overview of the occupations and opportunities for further training in woodworking and related fields.

Suggestions for Teachers

The core content for courses in woodworking at the advanced level of difficulty is the same as for courses at the general level. This content is specified in chart 2.1.1. Students studying at the advanced level of difficulty can be expected to deal with the content in greater theoretical depth. In addition to the core content indicated in chart 2.1.1 for general/advanced level courses, the following topics should be included in courses for the advanced level: 1(f)(g) (''Introduction''), 5(c)(d) (''Woodworking trades materials''), 8(a)(h) (''Foundations''), 9(g) (''Floor and ceiling construction''), 10(g) (''Wall construction''), 11(c)(e) (''Roof construction''), 13(e) (''Floor finishes''), 18(b) (''Insulating''), 22(c) (''Joining and fastening wood''). Courses should focus on design considerations and problem-solving tasks more than general level courses normally do. This difference in focus should be reflected in the objectives for the course.

Where time permits, optional content may be selected from other subjects within the construction grouping or from related subjects, such as architectural drafting or design studies, in other groupings. Any optional content should be selected to fit learning objectives planned for the course or particular themes selected as teaching strategies. In all cases, the content should reflect the ability and interests of the students who take their courses at the advanced level of difficulty.

Students taking their courses at this level may undertake some of the topics as independent study, particularly in bi-level courses, where the advanced level may be differentiated from the general level through the use of enrichment topics, themes, and special task assignments and projects. Technical-report writing on various woodworking topics must be included in the course.

Woodwork
Senior Division (Grades 11 and 12)

Woodworking courses for the Senior Division may be offered in one or more of three specialty areas: construction technology, carpentry, and industrial woodwork.

Construction technology. Courses in this subject area may be offered in Senior Division at basic, general, and advanced levels of difficulty. Planning for these courses will continue to be based on the curriculum guideline *Elements of Construction Technology, Senior Division, 1969* and the supplement to this guideline, published in 1970. The courses will provide an overview of the building construction industry as well as skill and knowledge associated with the carpentry trade. Students taking these courses will be prepared for further training in postsecondary institutions and in the building construction industry. The courses may vary in time allotment and may offer credit for up to 330 hours of in-school work each year. The course code for courses in this subject area will have the letters TCY as its stem.

Carpentry. Courses in this area of specialization may be offered in Senior Division at the basic and general levels of difficulty. Planning for these courses will continue to be based on the curriculum guideline *Elements of Construction Technology, Senior Division, 1969*. These courses should build on the skill and knowledge introduced through carpentry themes in the Intermediate Division and thereby facilitate students' entry into this trade. Topics from the list of content at the end of this module or from any other related grouping in technological studies may be included in these courses as required. Wherever possible, work experience and co-operative education programs should be planned to augment these courses. Carpentry courses may be designed for varying time allocations and may offer credit for up to 330 hours of in-school work each year. The course code for courses in this subject area will have the letters TCC as its stem.

Industrial woodwork. Courses in this subject area may be offered in Senior Division at basic and general levels of difficulty. Planning for these courses will be based on the curriculum guidelines *Elements of Construction Technology, Senior Division, 1969* and *Technical Subjects RP-27, Intermediate and Senior Divisions, 1963: Woodworking – Pattern and Casting Processes*. These courses may build on themes associated with cabinetmaking, millwork, and patternmaking – themes introduced as part of Grade 10 courses in the Intermediate Division. Topics from the list of content at the end of this module or from any related grouping in technological studies may be included in these courses as required. Themes associated with the occupation of industrial woodworker may also be planned for Senior Division courses; terminal performance objectives outlined for the basic apprenticeship course in the training profile *Industrial Woodworker* (published by the Ministry of Skills Development) may be included in course planning as required. Industrial woodwork courses may be designed for varying time allocations and may offer credit for up to 330 hours of in-school work each year in Grades 11 and 12. The course code for courses in this subject area will have the letters TML as its stem.

Work experience and co-operative education are two important aspects of a woodwork course that should be considered when students have acquired sufficient skills and knowledge to feel comfortable in an industrial or construction setting. Many of the fundamentals developed in a wood shop acquire new significance when students see them applied on the job. Working with adults, working in outdoor conditions, having to be punctual and to maintain good attendance, having to co-operate with fellow workers and accept supervision – all are valuable learning experiences available in the world of work.

Masonry and Trowel Trades
Intermediate Division (Grades 9 and 10)

Courses in masonry and trowel trades introduce students to the basic skills and knowledge necessary to lay bricks, blocks, and possibly stone, set tile, and create simple concrete shapes. The knowledge and skills gained from courses planned from this section will assist students in a variety of ways. For some students, the courses will provide general insight into a trade area that they may wish to study at greater depth in Grades 11 and 12, with the intention of eventually entering an apprenticeship. For other students, the courses will develop skills and knowledge that they will put to personal use.

Courses in masonry and trowel trades are authorized for Grades 9 and 10 at basic and general levels of difficulty. Chart 2.1.2 identifies the core content for these levels.

The aims and suggestions for designing courses at these levels are provided in the sections that follow the chart.

The amount of in-school time allotted for Intermediate Division courses in this subject may vary, depending on local requirements, from a minimum of approximately 55 hours over a two-year period to a maximum of 220 hours per year. If only the minimum time is available, then some of the core content will necessarily be given superficial treatment. It is suggested that fuller treatment be given to those core items related to safety, layout, trowel trades materials and processes, concrete construction, and basic brick- and blocklaying.

Chart 2.1.2
Core Content for Masonry and Trowel Trades
Intermediate Division (Grades 9 and 10)

Content Units	Core Content for Courses	
	Basic	*General*
1. Introduction	abde	abdefh
2. Safety	abcij	abcij
3. Project management	ab	cde
4. Layout	b	abe
6. Trowel trades materials and processes	a	abc
10. Wall construction	e	e
12. Wall and ceiling finishing	c	c
16. Concrete construction	a	a
17. Basic brick- and blocklaying	a	a

See "Course Content for the Construction Grouping", beginning on page 52, for description of the subunits a, b, c, etc.

Basic Level

Course codes assigned to basic level courses planned under this section will be TCT1B for Grade 9 and TCT2B for Grade 10.

Aims

In all courses based on this section, students will have the opportunity to:

- develop efficient communication skills, both written and oral, with emphasis on language associated with the trowel trades;
- develop the confidence and ability to attempt a new task;
- develop respect for others and a co-operative attitude towards peers and instructors/supervisors;
- develop responsible work habits and a positive attitude towards safety;
- develop the manual dexterity necessary in the masonry trades;
- develop a sense of pride in a job well done;
- develop a willingness to assume responsibility;
- acquire a positive attitude towards punctuality;
- develop familiarity with the basic tools and equipment of the masonry trades;
- practise the basic skills associated with the masonry trades;
- acquire knowledge of the various occupations related to the trowel trades.

Suggestions for Teachers

The spreading of mortar should be given special emphasis in courses based on this section. Knowing that they can spread mortar properly and can complete small, simple projects will encourage students to continue.

Because of the varied abilities of basic level students, there must be some flexibility in the evaluation process. In some cases, the practical mark may constitute 50 to 60 per cent of the final mark. The projects at this level must serve two purposes. First, they must develop skills progressively, and second, they must arouse the students' interests by being fun. An excellent example is building a brick column in a soldier position. This type of project may be carried out as a competition, in which the student who uses the most bricks is the winner. The value of such a project is that it emphasizes the need to keep projects plumb.

The development of life skills is an important aspect of basic level courses. Every opportunity should be taken to discuss real-life situations that concern students. Student questions may not come up at opportune times but nevertheless should be answered spontaneously and sincerely.

The instructor should regularly demonstrate, both to the class and to individual students, the appropriate manipulative skills for specific trowel trade tasks. A demonstration is often the most successful way to instruct students. It not only allows students to see how an operation should be performed but also serves as an inspiration to develop the skills necessary to perform a given task. Students studying at the basic level of difficulty often lack the ability to follow verbal instructions, but having seen a demonstration, they understand what is required and are quite capable of executing the task.

Safety is of prime importance in the field of construction. It is essential that students develop a positive attitude towards safe work habits. Excellent posters, films, and literature are available from the Construction Safety Association upon request. Representatives of the association are also prepared to come to a school to discuss construction safety with both the teacher and the students.

Teachers should feel free to select additional topics from the course content at the end of this module if students become involved in projects or themes that go beyond the core content. Programs should be designed to provide flexibility for coping with a wide variety of student skills, abilities, and interests.

Pride in one's work should be nurtured in students early in the program. All too often at the basic level, students are reluctant to lag behind their peers in completing projects. As a result, they may concern themselves more with timetables than with the quality of their work. The flexibility must exist to allow extra time if students need it.

Field trips and guest speakers may be used to introduce career discussions, particularly in Grade 10.

General Level

Course codes assigned to general level courses planned under this section will be TCT1G for Grade 9 and TCT2G for Grade 10.

Aims

In all courses based on this section, students will have the opportunity to:

- develop efficient communication skills, both written and oral, with emphasis on terminology associated with the trowel trades;
- develop a sense of pride in completing a task in an orderly and competent fashion;
- develop respect for others and a co-operative attitude towards peers and instructors/supervisors;
- appreciate the importance of safe work habits and procedures;
- develop dexterity in the use of hand tools and equipment involved in the masonry trades;
- develop the ability to use a spirit level properly;
- acquire general knowledge of the various occupations associated with the masonry and trowel trades;
- become familiar with the terms *plumb, level,* and *straight*;
- develop some leadership qualities;
- learn to accept critical evaluation;
- learn to work on and complete a project independently;
- develop time management and organizational skills in completing project work.

Suggestions for Teachers

Teachers planning courses at this level of difficulty should refer to the comments about skill development outlined in the preceding section for basic level courses. The basic skills and knowledge identified with the tasks are the same for both levels of difficulty. Students studying at the general level of difficulty may be expected to develop these basic skills in a little less time, but if their courses are shorter, their level of skill development will be about the same. General level programs should involve more theoretical material, and students may be expected to work on more complex projects. This does not mean that the theoretical aspect should become the dominant feature of the program. Students studying at this level of difficulty prefer a practical orientation. Because the repetitive aspect of skill development can become very tedious for students, teachers should attempt to develop skills through imaginative projects that will hold the students' interest. The more realistic the project, the easier it is to maintain a high level of interest. Challenging projects that require several class periods to complete make students eager to return to class.

Students studying at this level of difficulty will often be limited in their ability to read and write. It is important for teachers to recognize these limitations and to act accordingly when preparing instructional material or setting tests and exams for assessment purposes. The evaluation of student achievement should be weighted towards the practical aspect of the program. Brief oral tests, administered individually, and observation of students' performance on practical work assignments are often the most accurate measures of students' progress. Students should be given assignments that involve written material in order to improve communication skills. These assignments should be introduced gradually and should incorporate terminology associated with the masonry trade.

Students at the Intermediate level often enrol in technology courses with the intention of eventually entering one of the trades or a semiskilled occupation. It is important, therefore, to discuss the various career opportunities in the masonry trade. Bringing in a recent graduate who is employed in the trade or a young person who has just finished an apprenticeship gives students an ideal opportunity to discuss the pros and cons of the trade.

Young people tend to see themselves as employees, not employers, so it should be pointed out to them that once they have received their training, through apprenticeship or by some other route, it is possible to start up their own businesses. Bringing in a successful stonemason or tilesetter to talk to students about self-employment as a tradesperson can be worthwhile for students, whether they continue their training in masonry and trowel trades or in some other field.

In order to keep the students and the instructor as up to date as possible, it is an excellent practice to invite well-qualified tradespeople into the shop to evaluate the physical layout and the program. Such constant evaluation is effective not only in keeping the instructor up to date but also in providing reinforcement when physical changes are required to support the program.

Masonry and Trowel Trades
Senior Division (Grades 11 and 12)

Senior Division courses in trowel trades introduce students to a wide variety of construction trades and make them familiar with occupational opportunities. Students taking these courses may begin to specialize in one or more of the following trade categories: brick- and blocklaying, stonesetting, tilesetting, concrete technology, plastering, and drywall application and finishing.

Students may enrol in these courses to meet a variety of different needs. Students who successfully complete a program of courses based on this subject should have sufficient skills and knowledge to enter an apprenticeship upon graduation. Students who take architectural drafting or construction technology courses as related subjects may use their insights into these trades to continue with postsecondary studies and/or enter the general contracting field. For many students, the knowledge and skills they acquire from courses based on this section will be put to personal rather than vocational use. The program should develop in all students good work habits and pride in their work.

Courses in masonry and trowel trades are authorized for Grades 11 and 12 at basic and general levels of difficulty. Chart 2.1.3 identifies the core content for these levels. The aims and suggestions for designing courses at these levels are provided in the sections that follow the chart.

The courses may vary in time allotment and may be designed to offer credit for up to 330 hours of in-school work each year.

Chart 2.1.3
Core Content for Masonry and Trowel Trades
Senior Division (Grades 11 and 12)

Content Units	Core Content for Courses	
	Basic	*General*
1. Introduction	abde	abdefh
2. Safety	abcij	abcij
3. Project management	a	ac
4. Layout	abe	abde
6. Trowel trades materials and processes	abcd	abcd
8. Foundations	abef	abef
9. Floor and ceiling construction	a	ach
10. Wall construction	ef	ef
12. Wall and ceiling finishing	acd	acd
13. Floor finishes	ab	abc
15. Chimneys, fireplaces, and barbecues	a	a
16. Concrete construction	ab	ab
17. Basic brick- and blocklaying	ab	ab
21. Special machines	b	b

See "Course Content for the Construction Grouping", beginning on page 52, for description of the subunits a, b, c, etc.

Basic Level

Course codes assigned to basic level courses planned under this section will be TCT3B for Grade 11 and TCT4B for Grade 12.

Aims

In all courses based on this section, students will have the opportunity to:

- plan and complete a job in an orderly and competent fashion;
- acquire an overview of the masonry trade and the occupational opportunities within it;
- gain some practical experience on a building site through either a work experience program or a co-operative education program;
- learn to apply logical and sequential steps in solving a problem;
- design and build a masonry structure of a limited size;
- develop pride in good work;
- develop the ability to read a set of simple working drawings;
- acquire knowledge of the methods used in estimating materials and time schedules;
- learn to use the basic tools, machinery, and equipment of the masonry trade competently and safely;
- read articles in trade journals about new developments in the trade;
- develop the ability to communicate precisely and accurately on trade-related topics.

Suggestions for Teachers

Many students who enrol in these courses in Grades 11 and 12 are seriously thinking of entering one of the masonry trades. It is important, therefore, to do everything possible to inform students of the advantages and disadvantages of the various masonry and trowel trades. Field trips are often good sources of this type of information. However, an extended period on the job is probably the best way to learn exactly what it is like to work in a particular trade. A well-organized co-operative education component of a masonry trades program, giving students the opportunity to sample the various trades, may be the best way to facilitate this learning. In order for the co-operative program to provide a worthwhile learning experience for the student, several components of the program must be monitored. The instructor, in close co-operation with the employer, must ensure that the student's efforts lead to educational benefits. On the job site, the employer must provide close supervision of the student, critically appraising his or her efforts regularly.

While the student is on the co-operative program, he or she must be assured of the mutual reinforcement of the in-school and out-of-school components. Whether the student attends the out-of-school component one day a week or one period a day, the work situation with the employer must be monitored, and the skill areas that need development must be reinforced during the in-school component.

The most marketable skills that a young person can possess when seeking employment are well-developed work habits. Tidiness, punctuality, politeness, trustworthiness, and eagerness to learn are characteristics that employers seek in a new employee. The teacher who possesses and displays these traits has a much better chance of developing them in students. A clean, tidy, well-organized shop sets a good example for students of an efficient and safe working environment.

It is often difficult to design masonry projects that are meaningful to students and have a degree of permanence. A structure or project should last at least long enough to be perceived as a finished product. Too frequently, students build walls that have been torn down by the time they are next in the shop. In many cases, this hasty destruction is perceived as the only way a teacher can handle the project activity for the number of classes with which he or she is involved. However, the teacher can circumvent this problem by using large theme projects that involve many students over an extended time. Such projects can be excellent vehicles for developing skills and testing

creative ideas. They also provide situations in which values-related skills such as co-operation, leadership, and group planning can be developed. In some cases, such projects can be planned to involve other technical and academic subject groups. There is always a need for permanent masonry constructions within the school and the community. Students are very receptive to the idea of working on such projects. They realize that the results of their efforts will be on public display as a direct reflection of their abilities.

General Level

Course codes assigned to general level courses planned under this section will be TCT3G for Grade 11 and TCT4G for Grade 12.

Aims

In all courses based on this section, students will have the opportunity to:

- develop the ability to read architectural plans, estimate masonry costs, and develop lists of required masonry materials;
- develop the ability to work with others as either leader or member of a group;
- acquire creative skills in planning a masonry structure;
- develop the ability to plan and perform tasks efficiently, using a logical sequence of operations;
- acquire an overview of the masonry trade and the occupational opportunities that exist in it;
- design and build a small masonry structure;
- critically evaluate their own work and develop pride in its quality;
- understand basic theoretical concepts associated with the masonry trades;
- acquire practical experience through either a work experience or a co-operative education program.

Suggestions for Teachers

Teachers planning masonry trades courses for the general level of difficulty should review the suggestions outlined in the preceding section for basic level courses.

Senior Division students enrolled in general level courses in this subject should be given the opportunity to develop, in addition to the fundamental skills of the trades, some skills in designing, estimating, and drafting. Some of these students may eventually start up their own businesses; development of any related skills that could be supportive of such pursuits should also be considered when planning these courses.

Whenever possible, teachers in the masonry trades should attempt to discuss with the academic teachers methods of integrating their respective disciplines. Writing technical reports, making mathematical calculations, and investigating some of the scientific principles involved in the masonry trades all reinforce students' learning in the various disciplines and increase the relevance of students' education.

As Senior Division students develop their skills and become more mature, opportunities for small construction projects within the community may be sought. A flower box or a patio wall may be designed by a group of students and eventually erected on the site. This type of project requires careful planning and a study of the various problems that might arise. Such a project can lead to a structure that students helped plan and build and that serves a permanent and useful purpose in the community. Successful projects of this type are a source of pride and satisfaction for both the students and the community.

Heating, Refrigeration, and Air Conditioning
Intermediate Division (Grades 9 and 10)

Qualified tradespeople in heating, refrigeration, and air conditioning generally specialize in the machines and equipment related to one of these areas. Specialists, for example, can be refrigeration mechanics or heating specialists in oil, gas, or solar systems. In addition, there are many occupations that directly support these trades and require a comprehensive technical knowledge about these fields.

Students with aspirations to apprenticeship or further training in one of the occupations in this field will acquire from these courses some skill and knowledge in the three major areas. In addition to learning, through practical experiences, the nature of the work involved, they will acquire career information about further training programs, advancement possibilities, employment outlook, and working conditions. Students should be made aware that mathematics and physics provide important theoretical background for success in this field and that useful related subjects include mechanical drafting, blueprint reading, and electricity.

Intermediate Division courses in heating, refrigeration, and air conditioning, along with appropriate Senior Division courses, form a program that can lead to postsecondary training as a technician or technologist.

This postsecondary training can prepare students for related employment in the fields of production, systems design, installation, and maintenance. Technicians and technologists are often called on to help engineers design and prepare cost estimates for systems, to experimentally investigate new ways of using machines, and to supervise mechanics and work crews who perform installations.

Courses in heating, refrigeration, and air conditioning are authorized for Grades 9 and 10 at basic, general, and advanced levels of difficulty. Chart 2.1.4 identifies the core content for these levels. The aims and suggestions for designing courses at these levels are provided in the sections that follow the chart.

The amount of in-school time allotted for Intermediate Division courses in this subject may vary, depending on local requirements, from a minimum of approximately 55 hours over a two-year period to a maximum of 220 hours per year. If only the minimum time is available, then some of the core content will necessarily be given superficial treatment. It is suggested that fuller treatment be given to those core items related to safety, layout, building services materials, the conditioning of air, refrigeration systems, and pipe and tubing materials.

Chart 2.1.4
Core Content for Heating, Refrigeration, and Air Conditioning
Intermediate Division (Grades 9 and 10)

Content Units	Core Content for Courses	
	Basic	*General / Advanced*
1. Introduction	abde	abdef
2. Safety	abdfgk	abdfgk
3. Project management	ad	abcd
4. Layout	b	b
7. Building services materials	b	b
18. Insulating	abce	abce
24. The conditioning of air	ac	abc
25. Heating and cooling calculations	a	ab
26. Refrigeration	a	ab

Content Units	Core Content for Courses	
	Basic	*General / Advanced*
27. Refrigeration systems	a	a
28. Charging a system		a
48. Pipe and tubing materials	a	a
49. Physics of heat		a
50. Fundamentals of electricity		a
51. Testing and measuring		a

See ''Course Content for the Construction Grouping'', beginning on page 52, for description of the subunits a, b, c, etc.

Basic Level

Course codes assigned to basic level courses planned under this section will be TCH1B for Grade 9 and TCH2B for Grade 10.

Aims

In all courses based on this section, students will have the opportunity to:

- develop respect for and demonstrate the proper and safe use of hand and power tools, torches, chemicals, and refrigerants regularly used in the trade;
- select and use appropriate tools and fittings for cutting, reaming, flaring, swaging, bending, and joining copper tubing by soldering or brazing;
- learn how to solve problems associated with heating, refrigeration, and air conditioning systems;
- learn to use test equipment to make temperature, pressure, electrical, and linear measurements and to use the measured quantities in calculations;
- identify and state the function of various components of a refrigeration system;
- protect the safety of the individual and the group by developing safe work habits;
- develop a sense of pride in their accomplishments as they acquire basic trade skills and knowledge;
- develop knowledge of the employment opportunities and the training and entry requirements for the trades and other specialized occupations associated with heating, refrigeration, and air conditioning.

Suggestions for Teachers

The topics in unit 1 (''Introduction'') can be effectively presented in informal discussions.

In dealing with unit 2 (''Safety''), teachers should introduce rules related to specific operations, equipment, and environmental situations when the appropriate circumstances arise. General shop safety and the responsibility of every student to maintain it should be discussed at the beginning of the course. Students should also be made aware of the roles of the Construction Safety Association and the Industrial Accident Prevention Association in maintaining safety on the job. Objectives that will help the student develop safe work habits should be identified for each major learning activity planned for the course.

The content of units 24 (''The conditioning of air'') and 27 (''Refrigeration systems'') can be treated together in some instances. At the basic level, a simple explanation of the terms and the applications of the concepts is sufficient. In the Intermediate Division, students

need only be aware of the importance of proper system design and its relation to appropriate standards. No attempt should be made to teach the contents of written codes and standards in courses based on this section.

The content of unit 24 (''The conditioning of air'') can also provide a curriculum vehicle for the aim related to the use of elementary test equipment, tools, and techniques. The tools include thermometers, pressure gauges, electrical meters, linear measuring devices, and the basic hand tools used regularly in the trades associated with this subject field. Basic level activities should be limited to simple circuit tracing, meter reading, and adjustment of components.

When structuring the content of unit 48 (''Pipe and tubing materials'') into the course, the teacher must select appropriate projects in order to achieve course objectives. Projects involving cutting, fitting, and joining copper tubing can be used to develop these techniques and to make students aware of the total process of which each technique is a part. The degree of accuracy in accomplishing a particular project can serve as an assessment criterion. Assignment of numerous practice pieces is not a recommended strategy for teaching joining and forming skills.

Every effort must be made to involve students in a planned series of projects and work activities that provide practical reinforcement of their developing knowledge and expertise. The construction of working models or of a complete heating or cooling unit each year or every other year is far more meaningful than projects that are seen by students as having no practical purpose.

Teachers with expertise in one of the major trade areas of this section may develop a theme with this trade focus. The optional content can be selected to support the core learning and to amplify the theme. In a course that emphasizes the theme of heating, for example, optional topics can be selected from the sheet metal section of the manufacturing module to support the ductwork aspects of warm-air heating, or from the plumbing section to support an emphasis on hot-water or steam heating. Some effort should be made to deal with alternative energy sources in the production of heat. The installation and maintenance of oil and gas burners can also be the bases for optional themes.

A teacher with a background as a refrigeration and air conditioning mechanic might choose to emphasize both aspects of this trade. This teacher could develop a course with the theme of air conditioning to support the core content and aims in Grade 9. The Grade 10 course could then emphasize the application of the core content to refrigeration systems.

In each grade, additional topics beyond the core content may be selected, from the list of course content for the construction grouping at the end of this module, to support the theme and to maintain student interest.

General Level

Course codes assigned to general level courses planned under this section will be TCH1G for Grade 9 and TCH2G for Grade 10.

Aims

In all courses based on this section, students will have the opportunity to:

- become proficient in the safe use of hand and power tools, torches, chemicals, and refrigerants regularly used in the trade;
- learn to complete with precision various operations involving bending, fitting, and joining of copper tubing and wiring;
- learn to recognize and solve problems, develop alternative solutions, and make choices;

- learn to use elementary test equipment, to make measurements (temperature, pressure, electrical, and mechanical), and to complete minor adjustments and repairs to individual components and systems;
- learn the physics of refrigeration – how heat is transferred, types of heat, intensity of heat, and quantities of heat;
- learn the operation of the refrigeration cycle and the functions of the main components in a refrigeration system;
- acquire an introductory understanding of electrical fundamentals, splices and joints, circuit protection, power consumption, and the use of simple test instruments to find faults;
- protect the safety of the individual and the group by developing safe work habits and a positive attitude towards safety in all work situations;
- develop a sense of pride in their basic trade skills and knowledge;
- develop a perspective on the construction industry and the role of the heating, refrigeration, and air conditioning trades within it;
- learn about employment opportunities and training and entry requirements for the trades and other specialized occupations associated with heating, refrigeration, and air conditioning;
- develop an understanding and respect for the role of energy in our society and for its efficient use and conservation.

Suggestions for Teachers

The learning activities planned for general level courses based on this section should be exploratory. Every effort should be made to involve the student in developing appropriate trade skills and performing a variety of work activities related to technology in this subject field. When selecting optional content for these courses, therefore, teachers should avoid theoretical topics such as heat gains, heat loss, relative humidity, comfort temperatures, system designs, ventilation, and control systems; these topics are more appropriate for Senior Division courses.

Suggestions outlined in the preceding section for basic level courses can be readily adapted to the planning of general level courses based on this section.

The topics in unit 1 (''Introduction'') of the core content are intended to provide students with background information related to work and further training opportunities in heating, refrigeration, and air conditioning occupations. This content can be presented most effectively through informal discussions when opportunities occur during the course.

The responsibility of every student to maintain a safe work environment should be discussed very early in the course. Students should be made aware of the roles of the Construction Safety Association and the Industrial Accident Prevention Association in maintaining safety on the job. Safety rules related to specific operations, equipment, and environmental situations should be introduced and stressed during the course when the appropriate circumstances arise.

Some topics in unit 24 (''The conditioning of air'') overlap with topics in unit 27 (''Refrigeration systems''). Such topics include components and their functions, temperature and pressure cycles, and compression systems. Presentation of practical applications of these topics will facilitate learning.

Students should be made aware that proper system design is critical and that it requires meeting relevant standards. However, no attempts should be made in the Intermediate Division to teach the contents of written codes and standards.

Courses at the general level should develop the students' skills and theoretical knowledge through practical projects and experiments. The sequence of these activities should provide the students with practical reinforcement of their developing knowledge and expertise. Construction of working models or of a complete heating or cooling unit over one or two years is more meaningful than projects that have no practical purpose in the students' view. When developing the content of unit 48 (''Pipe and tubing materials''), the teacher

should select activities and projects that support knowledge and skill objectives and that are perceived by students as contributing to a larger theme.

The theoretical concepts identified in unit 49 (''Physics of heat'') should be probed in conjunction with related practical activities. Measurements and calculations of quantities should be integral parts of this course work at the general level of difficulty.

The content of units 50 (''Fundamentals of electricity'') and 51 (''Testing and measuring'') is intended to develop the students' ability to make measurements of various physical parameters in the system, to read instrument scales, and to interpret the readings relative to some specific standard. Introductory activities related to this content may focus on determining pressure, temperature, and electrical and linear values. However, as the activities become more complex, they may involve reading simple schematic diagrams, graphs, and tables; making calculations to check the readings; and relating measured and calculated values to manufacturers' specifications. For many students, it is through adjustments of pressure, temperature, and electrical values in the system and minor repairs of components that the electrical and mechanical aspects of the technology are most readily understood.

Advanced Level

Course codes assigned to advanced level courses planned under this section will be TCH1A for Grade 9 and TCH2A for Grade 10.

Aims

In all courses based on this section, students will have the opportunity to:

- learn to use hand tools, power tools, and other equipment to perform work tasks commonly required in the heating, refrigeration, and air conditioning industry;
- acquire safe work habits and a positive attitude towards the safety of others;
- learn to plan and perform tasks in a logical sequence;
- acquire an introductory understanding of electrical fundamentals;
- develop skill in using test equipment to check, maintain, and identify problems related to the installation and servicing of heating, refrigeration, and air conditioning equipment;
- describe the operation of the refrigeration cycle and explain the function of the various components;
- do trade calculations involving applications of physical laws related to heat;
- acquire an overview of the construction industry and a perspective on the role of the heating, refrigeration, and air conditioning trades within it;
- develop insights into energy consumption in our society and an understanding of the need for efficient use and conservation of energy;
- learn about employment opportunities in and training and educational requirements for the various occupations in the industry.

Suggestions for Teachers

The core content for courses in heating, refrigeration, and air conditioning at the advanced level of difficulty is the same as for courses at the general level. This content is specified in chart 2.1.4. Students studying at the advanced level of difficulty can be expected to deal with the content in greater theoretical depth, but theory should be perceived by students as a natural extension of their practical work. Suggestions in the preceding section for general level courses can be adapted for courses at the advanced level.

Emphasis should be placed on developing thinking skills necessary for practical problem solving. The ability to recognize superior design features in various models of equipment associated with the industry is a useful achievement in this direction. Advanced level courses should focus on these design considerations and problem-solving tasks more than general level courses do. This difference in focus should be reflected in the objectives for the course.

Where time permits, optional content may be selected from other subjects within the construction grouping or from related subjects in other groupings, such as blueprint reading or design studies. The optional content in each case should be selected to fit learning objectives planned for the course or particular themes selected as teaching strategies. The content should reflect the ability and interests of the students who take their courses at the advanced level of difficulty.

Students at the advanced level may undertake some of the topics as independent study, particularly in bi-level courses, where the advanced level may be differentiated from the general level through the use of enrichment topics, themes, and special task assignments and projects. Students should be encouraged to explore the course content on their own. This exploration can be facilitated by written research assignments and oral presentations of technical reports. This approach works especially well with gifted students and those who show a particular interest in the course. To incorporate the concept of ''language across the curriculum'', evaluation of these assignments and reports should consider the student's use of language as well as the technical content.

Teachers should attempt to introduce information on career opportunities whenever possible, through newspaper and magazine articles, films and filmstrips, and career speakers from industry. School guidance counsellors are often a useful resource.

Heating, Refrigeration, and Air Conditioning

Senior Division (Grades 11 and 12)

Senior Division courses in heating, refrigeration, and air conditioning may be offered at the basic, general, and advanced levels of difficulty. Planning for these courses will continue to be based on the curriculum guideline *Technical Subjects RP-27, Intermediate and Senior Divisions, 1963: Air Conditioning and Refrigeration.*

Courses planned under this subject guideline can prepare students for further training in and entry into the trade of refrigeration and air conditioning mechanic, as well as related occupations such as systems designer, sales technician, oil burner service mechanic, gas fitter, and central or room air conditioning servicer and installer. Training modules prepared by the Skills Development Ministry to support occupations related to the heating, refrigeration, and air conditioning industry can also support objectives in courses for the Senior Division. (Information on this material is available from the directors of the regional offices of the Ministry of Education.) The modules may be utilized by schools as aids either in choosing specific subject content for Senior Division courses or in structuring a program that will facilitate further study at local colleges of applied arts and technology.

Courses planned for this subject area will have the letters TCH as the stem of their course code.

Plumbing and Pipefitting
Intermediate Division (Grades 9 and 10)

Intermediate Division courses in plumbing and pipefitting will introduce students to the various types of skills and knowledge utilized in the plumbing trade and other pipefitting occupations. The possible vocational applications of this learning to both residential and industrial situations will be explored for career-planning purposes. Challenging opportunities in the pipefitting occupations are to be found in industrial plants such as oil refineries, petrochemical plants, pulp-and-paper mills, and food processing plants. As part of the course, students will become familiar with apprenticeship requirements for both the plumber and steamfitter trades as well as local training opportunities in these trades and related occupations. All students aspiring to careers in this subject field should be made aware that courses in other technological subjects (e.g., welding, drafting, and blueprint reading) and in mathematics are important corequisites to their training.

Some students will use the learning acquired through the course personally rather than vocationally. The ability to plan, install, and maintain simple water supply and disposal systems is a useful asset in a home-owner.

Courses in plumbing and pipefitting are authorized for Grades 9 and 10 at basic and general levels of difficulty. Chart 2.1.5 identifies the core content for these levels. The aims and suggestions for designing courses at these levels are provided in the sections that follow the chart.

The amount of in-school time allotted for Intermediate Division courses in this subject may vary, depending on local requirements, from a minimum of approximately 55 hours over a two-year period to a maximum of 220 hours per year. If only the minimum time is available, then some of the core content will necessarily be given superficial treatment. It is suggested that fuller treatment be given to those core items related to safety, layout, building services materials, plumbing systems and fixtures, drainage systems, and venting.

Chart 2.1.5
Core Content for Plumbing and Pipefitting
Intermediate Division (Grades 9 and 10)

Content Units	Core Content for Courses	
	Basic	*General*
1. Introduction	abcdeh	abcdefh
2. Safety	adgh	adgh
3. Project management	ab	abc
4. Layout	be	be
7. Building services materials	a	a
18. Insulating	d	d
21. Special machines	c	c
29. Plumbing systems and fixtures	ab	ab
30. Drainage systems	a	ab
31. Venting	a	ab
48. Pipe and tubing materials	a	a

See "Course Content for the Construction Grouping", beginning on page 52, for description of the subunits a, b, c, etc.

Basic Level

Course codes assigned to basic level courses planned under this section will be TCP1B for Grade 9 and TCP2B for Grade 10.

Aims

In all courses based on this section, students will have the opportunity to:

- demonstrate proficiency in the safe use of the hand and power tools, measuring devices, torches, and soldering equipment regularly used in the plumbing and pipefitting trade;
- recognize and identify the various components and materials (such as cast iron, lead, steel, copper, and various plastics) regularly used in plumbing and pipefitting;
- demonstrate a general understanding of the requirements for installing, adjusting, and repairing simple plumbing systems;
- develop a positive attitude towards maintaining safety in the workplace;
- improve skills in interpreting both oral and written instructions pertaining to the plumbing trade;
- critically evaluate their own work and develop pride in its quality;
- develop a positive attitude towards working co-operatively with both peers and supervisors;
- acquire a perspective on the plumbing and pipefitting trade and learn about related occupational and training opportunities.

Suggestions for Teachers

In planning courses at the basic level, every effort should be made to include as much practical work as possible. It is important to demonstrate to students why they must develop basic skills before they can attempt a plumbing installation. A project that allows the students to solder a few fittings and then test whether or not they leak is a good way to illustrate the importance of developing a basic skill. Once the basic skills have been developed, students should be given the opportunity to install a plumbing fixture. It requires considerable planning to provide students with a well-rounded experience in the installation of various plumbing fixtures and ensure that space is available to accommodate these projects. Teachers should consider storing fixtures in an external area and bringing them in when they are required. A neat, orderly shop has a significant influence on students' housekeeping habits. It also provides a safer work environment.

Students in Grades 9 and 10 are investigating a series of possible occupational areas. They seldom have a clear picture of what opportunities exist in a particular trade. It is important for a teacher to discuss with the students the various aspects of the plumbing and pipefitting trade and to point out the advantages and disadvantages of the trade. Topics in unit 1 (''Introduction'') related to this background can be effectively presented in informal discussions.

The safety rules related to specific operations, equipment, and environmental situations identified in unit 2 (''Safety'') should be presented as appropriate circumstances arise. General shop safety and the responsibility of every student to maintain it should be discussed at the beginning of the course and adhered to throughout the course. Students should also be made aware of the role of the Construction Safety Association in maintaining safety on the job.

The contents of unit 7(a) (''Building services materials'') and unit 29 (''Plumbing systems and fixtures'') can be treated together in accomplishing several of the aims. The selection of appropriate projects is fundamental to achieving the course objectives. Every effort must be made to involve students in a planned

series of practical activities that reinforce their developing knowledge and expertise. The nature and complexity of these experiences must, of course, reflect the level of difficulty at which the course is offered. Construction of working models or of a simple plumbing system each year or every two years is more meaningful than projects that are seen by students as having no practical purpose.

General Level

Course codes assigned to general level courses planned under this section will be TCP1G for Grade 9 and TCP2G for Grade 10.

Aims

In all courses based on this section, students will have the opportunity to:

- complete various operations (such as measuring, cutting, threading, soldering, bending, fitting, assembling, and supporting) required for installing a pipe system to specifications;
- demonstrate some proficiency in the use and interpretation of federal and local plumbing codes;
- determine from drawings and specifications estimates of the materials required and the layout of simple water supply and disposal systems;
- demonstrate proficiency in the safe use of the hand and power tools, measuring devices, torches, and soldering equipment regularly used;
- develop a sense of pride in their achievements as they acquire skills and knowledge in the trade;
- develop safe working habits and positive attitudes towards the maintenance of a safe working environment for themselves and their fellow workers;
- acquire the knowledge they need to plan a career and to pursue further training and employment opportunities in occupations related to the plumbing and pipefitting field.

Suggestions for Teachers

Some of the suggestions outlined in the preceding section for basic level courses can be adapted for courses being planned at the general level of difficulty.

The plumbing and pipefitting courses offered to students at the general level of difficulty should be exploratory in nature. Students should be given as much information as possible about the various vocational opportunities associated with the skills learned in the course. Having a recently graduated employee return for a talk with interested students is often an excellent way of providing the students with some insight. Students should have an opportunity, if possible, to visit a construction site, see plumbing installations at various stages, and observe other actual operations.

Safety is an extremely important issue that must be dealt with continually. Safe soldering techniques, fire protection, proper methods of handling piping and other materials, and safe procedures for using power and hand tools are all important topics that must be taught. The shop should be well ventilated and be kept neat and clean.

Water heaters and water softeners are two applications that can support the topics outlined as core content under unit 29 (''Plumbing systems and fixtures''). The theoretical function and operation of water heaters and softeners can also be studied as optional content.

Although the courses at this level of difficulty should be mainly practical in nature, some fundamental theory of the trade should be introduced. Students should be evaluated in both the practical and theoretical aspects of the course, but with a strong emphasis on practical achievements. Short written tests involving a limited number of topics are often a better method of assessing student progress than an extensive exam. Frequently checking the student's progress on project work by asking a few pertinent questions regarding activities related to the project is an excellent way of determining how well the student is doing. Students should be made aware at the beginning of the course that this form of evaluation will be used. Additional comments about the evaluation of student achievement are outlined on pages 2-3 of this module and on page 24 of *Technological Studies, Part A: Policy for Program Planning*.

Plumbing and Pipefitting
Senior Division (Grades 11 and 12)

Senior Division courses in plumbing and pipefitting may be offered at the basic and general levels of difficulty. Planning of these courses will continue to be based on the plumbing curriculum guideline in *Technical Subjects RP-27, Intermediate and Senior Divisions, 1963*.

Courses planned under this guideline at the general level can provide a good base of introductory skills and knowledge for students who plan to enter apprenticeship in the trade of plumber or steamfitter. The training profile for these trades, prepared by the Skills Development Ministry, may be used as a resource when planning these courses.

Courses planned for the basic level can be aimed at students who are interested in plumbing for personal use or for use in other occupations such as building maintenance or heating, refrigeration, and air conditioning. Courses of this type may also be offered at the general level.

Courses planned for this subject area will have the letters TCP as the stem of their course code.

Building and Equipment Maintenance
Intermediate Division (Grades 9 and 10)

Buildings and equipment of all types require maintenance from the time of construction to the time of demolition or replacement. Extended utilization and efficient service are the main purposes of such maintenance work. To do this type of work safely and efficiently requires training, practice, and the development of appropriate attitudes. The wide variety of structures and equipment requiring regular maintenance can best be served by workers with mechanical/technical aptitudes and the knowledge and skills associated with many of the basic trades. Work in this diverse career area offers the student an opportunity for scope, responsibility, and challenge.

Courses in building and equipment maintenance are authorized for Grades 9 and 10 at basic and general levels of difficulty. Chart 2.1.6 identifies the core content for these levels. The aims and suggestions for designing courses at these levels are provided in the sections that follow the chart.

The courses may vary in time allotment and may be designed to offer credit for up to 220 hours of in-school work each year.

Chart 2.1.6
Core Content for Building and Equipment Maintenance
Intermediate Division (Grades 9 and 10)

Content Units	Core Content for Courses	
	Basic	*General*
1. Introduction	adeg	adefg
2. Safety	adgij	adgij
3. Project management	ad	ad
24. The conditioning of air		b
29. Plumbing systems and fixtures	a	a
30. Drainage systems	c	
32. Cleaning processes	ab	ab
37. General maintenance (equipment)	a	a
38. General maintenance (custodial)		cd
48. Pipe and tubing materials	a	a
52. Fire control	a	a

See "Course Content for the Construction Grouping", beginning on page 52, for description of the subunits a, b, c, etc.

Basic Level

Course codes assigned to basic level courses planned under this section will be TCM1B for Grade 9 and TCM2B for Grade 10.

Aims

In all courses based on this section, students will have the opportunity to:

- develop a positive attitude towards maintaining safety in the workplace and using safe work habits when performing a task;
- develop the ability to use hand and power tools properly in building maintenance tasks;
- acquire general knowledge of basic operations in the trades normally involved in maintaining the various systems within a building;
- develop the ability to understand and follow both oral and written instructions;
- develop interpersonal skills and the ability to work with others co-operatively;
- critically evaluate their own work and develop pride in its quality;
- develop the ability to plan and perform a task involving building and equipment maintenance using a logical sequence of operations;
- acquire an understanding of the career opportunities involved in the building and equipment maintenance services.

Suggestions for Teachers

In Grade 9 courses, the knowledge and skills identified under core content and aims should be introduced through practical activities that each student can successfully complete. In courses at the basic level of difficulty, it is particularly important that each student gain confidence in his or her ability to master the learning. This learning should be linked to language and mathematical studies wherever possible.

The theory side of these courses can involve the study of the building and of systems for human shelter. The practical side can consist of the use and operation of tools, care and operation of machines, and techniques used on related maintenance projects.

Courses in the second year (Grade 10) will review, in greater depth, the first year's work. New materials and equipment can be introduced in these courses. A theme for the second year of a course offered at the basic level of difficulty could be the service systems of a building, and the repair and adjustment of those systems. The concept of maintaining the environment to best serve human needs and comfort should be emphasized throughout courses at the basic and general levels.

General Level

Course codes assigned to general level courses planned under this section will be TCM1G for Grade 9 and TCM2G for Grade 10.

Aims

In all courses based on this section, students will have the opportunity to:

- develop skill in the use of hand tools, power tools, and building services equipment;
- acquire understanding of various maintenance problems and of ways to proceed in solving them;
- develop familiarity with the properties and uses of maintenance materials;

- investigate a variety of preventive maintenance tasks;
- develop technical/mechanical aptitudes and special talents related to maintaining buildings and equipment;
- develop pride in their work on maintenance tasks and confidence in their ability to work responsibly on their own;
- acquire ''safety consciousness'' relative to their own work methods and the people for whom their services are performed;
- acquire knowledge of career opportunities in the building and equipment service industry.

Suggestions for Teachers

Students studying this subject at the general level of difficulty should be introduced to some of the basic theoretical concepts involved in the various systems within the building. Such systems as plumbing, electricity, heating, and air conditioning should be investigated. Although it is not essential for the students to understand all aspects of a particular system, they should be given a general overview. Repairing a water faucet and clearing a drain are the types of practical activities that should be considered when dealing with the plumbing system.

Teachers preparing courses in this subject should discuss the various systems with teachers or specialists who are familiar with work activities related to one or more of the systems. For example, a teacher who teaches electricity or a well-informed plumber may be able to provide excellent advice on the kinds of practical projects that can be incorporated into the course. Field trips to local plants or apartment buildings should be arranged so that students can acquire first-hand information on how these systems are serviced by professionals. The school itself is an excellent example of a functioning plant: students should learn how it is maintained.

Students may be given home assignments that require them to investigate the systems within their own dwellings, be they apartments or houses. In the former case, a letter from the school requesting co-operation from the building superintendent may be required. It is very important for the teacher to emphasize the safety aspects of each system so that students will not endanger themselves or the systems during their investigations.

Student evaluation should be based mainly on achievements in practical assignments. Frequently students studying at the general level have difficulty with written material, and this problem should be taken into consideration in the assessment process. Short, individual, oral tests are often a much better measure of how much the student knows than are lengthy written tests. Additional comments about the evaluation of student achievement are outlined on pages 2-3 of this module and on page 24 of *Technological Studies, Part A: Policy for Program Planning*.

Students taking courses in Grades 9 and 10 at the general level of difficulty should learn the basic skills more rapidly than those at the basic level and should move into group activities at an earlier stage. The selection of additional content beyond that specified in chart 2.1.6 should be made from the ''Course Content for the Construction Grouping'' section at the end of this module or from content listed in other subject groupings of Part B. Such content should support new projects or themes that students undertake.

Building and Equipment Maintenance
Senior Division (Grades 11 and 12)

Building and equipment maintenance courses can prepare students for occupations ranging from the care of a private home to industrial plant maintenance and management. These courses are interdisciplinary and offer many opportunities for students to perform socially important tasks in the process of learning. Students should also learn to analyse maintenance problems and devise solutions involving skills related to various trades.

Students taking courses in this subject field will learn the importance of working efficiently, accepting responsibility, and being trustworthy. The many career opportunities that exist in this field, in all sectors of technological endeavour, require these traits.

Courses in building and equipment maintenance are authorized for Grades 11 and 12 at basic and general levels of difficulty. Chart 2.1.7 identifies the core content for these levels. The aims and suggestions for designing courses at these levels are provided in the sections that follow the chart.

The courses may vary in time allotment and may be designed to offer credit for up to 330 hours of in-school work each year.

Chart 2.1.7
Core Content for Building and Equipment Maintenance
Senior Division (Grades 11 and 12)

Content Units	Core Content for Courses	
	Basic	*General*
1. Introduction	adefh	adefh
2. Safety	abdgij	abdgij
3. Project management	acd	acd
24. The conditioning of air		cd
29. Plumbing systems and fixtures	a	
30. Drainage systems	c	
32. Cleaning processes	abd	ab
36. Furniture care	a	
37. General maintenance (equipment)	c	b
38. General maintenance (custodial)	a	
50. Fundamentals of electricity	a	a
52. Fire control	a	

See ''Course Content for the Construction Grouping'', beginning on page 52, for description of the subunits a, b, c, etc.

Basic Level

Course codes assigned to basic level courses planned under this section will be TCM3B for Grade 11 and TCM4B for Grade 12.

Aims

In all courses based on this section, students will have the opportunity to:

- develop the interpersonal skills necessary to work co-operatively with peers and supervisors;
- acquire the skills and knowledge necessary to provide a preventive maintenance program;
- develop the confidence necessary to perform maintenance tasks on their own initiative;
- develop the ability to use both hand and power tools safely and efficiently;
- acquire the skills necessary to perform maintenance tasks related to the various systems within a building;
- develop communication skills appropriate to employment in the building and equipment maintenance trades;
- explore the variety of work tasks involved in occupations related to the building and maintenance trades.

Suggestions for Teachers

The core content for basic level courses in Senior Division focuses on various aspects of building maintenance and is intended to build on the core learning of Intermediate Division courses. Core content common to the two divisions will be reviewed and treated at greater depth in Senior Division courses. Optional content planned for Senior Division courses may either extend the study of building services or explore topics related to the maintenance of equipment.

Where feasible, Senior Division courses may stress particular building or equipment maintenance needs of local industry. This emphasis is most desirable when work experience or co-operative education programs can be established with local industry to reinforce and build on the skills that students acquire in school.

Students should investigate, in addition to the physical activities required on the job, the variety of written reports and forms that workers in these occupations may have to complete. Follow-up activities in the school, related to these practical needs on the job, can reinforce and improve the students' communication skills.

Students in these courses should develop safe work habits. They should also develop an awareness of hazards to the safety of individuals wherever work is in progress. In building maintenance tasks, work sites should never be left in a condition that is not safe for others. The safety awareness that students develop in these courses should carry over into all of their activities.

As a wide variety of skills are taught in building and equipment maintenance courses, the "learn, use, teach" cycle can provide a useful strategy. In this cycle, the student first learns a skill under the close supervision of the teacher. During the use phase, the student applies the skill independently. The teach phase then requires the student to demonstrate the skill to another person. Usually this teach phase requires close initial support from the teacher to be effective.

General Level

Course codes assigned to general level courses planned under this section will be TCM3G for Grade 11 and TCM4G for Grade 12.

Aims

In all courses based on this section, students will have the opportunity to:

- solve problems, develop alternative solutions, and make choices relative to building and equipment maintenance;
- develop skills in the use of hand tools, power tools, and building services equipment;
- acquire understanding of various maintenance problems and of ways to proceed in solving these problems;
- develop familiarity with the properties and uses of maintenance materials;
- investigate maintenance tasks from a preventive maintenance perspective;
- acquire "safety consciousness" relative to their own work methods and the people for whom their services are performed;
- acquire knowledge of employment opportunities in the various occupations associated with building and equipment maintenance;
- acquire the interpersonal skills needed to function well in a service-oriented industry.

Suggestions for Teachers

The core content indicated in chart 2.1.7 for general level courses focuses on the general maintenance of both equipment and buildings. It is intended to continue the development of skill, knowledge, and attitudes introduced in the core learning for this subject in the Intermediate Division.

From the list at the end of this module, additional content may be selected to support themes concerning local employment opportunities in building and equipment maintenance. Content may also be selected from other subject groupings, such as horticulture or transportation, to further broaden the range of skills that may be utilized in occupations associated with this diverse field. In either case, the additional content should be selected to support learning objectives related to the aims.

Where possible, students should have opportunities in the Senior Division years to work in groups on projects that require co-ordination. These may be renovation projects on out-of-school sites. This type of project can sometimes be arranged in conjunction with social agencies and other groups in the community.

On-the-job work experience gives students the chance to apply and further develop the skills and knowledge acquired in school. It can also help them to form positive attitudes towards work and can provide insights into employment opportunities and related careers.

Suggestions in the preceding section for basic level courses can be adapted to suit general level courses.

Custodial Services
Intermediate Division (Grades 9 and 10)

All buildings have to be cleaned and maintained. Doing this type of work efficiently requires training and practice. The variety of surfaces to be cared for, the equipment to be kept in working order, and the opportunities for both indoor and outdoor work make such jobs interesting and challenging.

Courses in custodial services offered during Grades 9 and 10 can provide students with opportunities to explore their aptitude for and interest in occupations in this service field.

Courses in custodial services are authorized for Grades 9 and 10 at the basic level of difficulty. Chart 2.1.8 identifies the core content. The aims and suggestions for designing courses are provided in the sections that follow the chart.

The courses may vary in time allotment and may be designed to offer credit for up to 220 hours of in-school work each year.

Chart 2.1.8
Core Content for Custodial Services
Intermediate Division (Grades 9 and 10)

Content Units	Core Content for Courses
	Basic
1. Introduction	bcefg
2. Safety	adgi
3. Project management	a
13. Floor finishes	g
32. Cleaning processes	a
33. Cleaning washrooms	a
34. Window and glass cleaning and cutting	a
35. Waste collection	a
37. General maintenance (equipment)	d

See ''Course Content for the Construction Grouping'', beginning on page 52, for description of the subunits a, b, c, etc.

Basic Level

Course codes assigned to basic level courses planned under this section will be TCS1B for Grade 9 and TCS2B for Grade 10.

Aims

In all courses based on this section, students will have the opportunity to:

- develop the ability to use both hand and power cleaning equipment safely and efficiently;
- acquire a sense of satisfaction in seeing a cleaning or maintenance task through to completion;
- develop the skills and knowledge necessary to plan and complete a cleaning and maintenance task;
- become familiar with the uses and applications of the various cleaning solutions;
- develop the ability to work with others cooperatively and effectively;
- develop safe and efficient practices for storage of equipment and supplies;

- acquire knowledge and understanding of maintenance problems and techniques for solving them;
- acquire safe working habits and a positive attitude towards the safety of others;
- acquire knowledge of careers and further training opportunities in the custodial services field.

Suggestions for Teachers

The development of students' co-ordination and confidence in performing tasks related to this subject should be the main objective of the Grade 9 course. The theory side of the course involves the study of consumable cleaning materials, structures, and service systems for human shelter. The practical side consists of the use and operation of tools, machines, and techniques in custodial projects.

The Grade 10 course will review in greater depth the content covered by the first-year course. Some new materials and more sophisticated equipment should be introduced. A basic understanding of the service systems of a building and techniques for effecting minor repairs and adjustments to those systems will be part of these courses. The human needs and comfort of building occupants should be given continual emphasis.

In dealing with the content of unit 2 (''Safety''), teachers should introduce safety rules related to specific materials, equipment, operations, or environmental situations when the appropriate circumstance arises. General shop safety and the responsibility of every student to maintain it should be discussed at the beginning of the course and closely adhered to throughout the course.

Students should be involved in a planned series of jobs and in experiments that provide practical reinforcement of their developing knowledge and expertise. For these activities to be meaningful to the students, their practical purpose must be clearly evident.

Students can be involved in making a simple floor plan of the school. The plan can then be subdivided into areas, and from this, a schedule can be drawn up indicating what area each student is assigned to for custodial purposes. There should be a rotation in the schedule so that students have an opportunity to work in all areas. In this way, students can be introduced to some of the principles of drafting and can acquire an understanding of a floor plan. As the students progress, additional details can be added to their plan, such as the location of the fire alarm boxes and the fire extinguisher, the emergency exits, and other details that might be involved in the maintenance of the building.

Teachers should be aware of and sympathetic towards personality traits of students. A positive self-image and an attitude of satisfaction from work tasks that are well done are probably the most important traits that a teacher can attempt to develop in students who take these courses. Students should be made aware of the importance of maintaining a neat appearance. The ability to converse with others properly and pleasantly is another skill that the teacher should continually stress.

Students should become familiar with the terminology used in describing the various systems (plumbing, heating, lighting, etc.) within a building. Although custodians are not generally responsible for repairing such systems, they should recognize when something requires repairs and be able to report the fault.

Courses in custodial services can lead to the tangible goal of satisfying and rewarding employment for the student. Visits by workers and supervisors in this career field can provide useful career orientation for the student, even during the student's exploratory course.

Custodial Services
Senior Division (Grades 11 and 12)

Students in this occupational area must be capable of working efficiently without supervision. They must be able to accept responsibility and assume the trust that these occupations often require. For people with these qualifications, many opportunities exist for employment in factories, office buildings, apartment complexes, and shopping malls and in the operation of their own businesses. Senior Division courses in custodial services can provide students with the opportunity to prepare for entry into an occupation in this service field.

Courses in custodial services are authorized for Grades 11 and 12 at the basic level of difficulty. Chart 2.1.9 identifies the core content. The aims and suggestions for designing courses at this level are provided in the sections that follow the chart.

The courses may vary in time allotment and may be designed to offer credit for up to 330 hours of in-school work each year.

Chart 2.1.9
Core Content for Custodial Services
Senior Division (Grades 11 and 12)

Content Units	Core Content for Courses
	Basic
1. Introduction	bdfg
2. Safety	adgi
3. Project management	a
13. Floor finishes	bg
32. Cleaning processes	abce
34. Window and glass cleaning and cutting	b
35. Waste collection	b
37. General maintenance (equipment)	d
38. General maintenance (custodial)	bc

See "Course Content for the Construction Grouping", beginning on page 52, for description of the subunits a, b, c, etc.

Basic Level

Course codes assigned to basic level courses planned under this section will be TCS3B for Grade 11 and TCS4B for Grade 12.

Aims

In all courses based on this section, students will have the opportunity to:

- develop skill in the use of hand and power tools and equipment related to the cleaning and maintenance of residential and commercial establishments;
- develop pride in the quality of their work on maintenance tasks and confidence in their ability to work responsibly on their own;
- acquire knowledge and understanding of maintenance problems related to custodial and building services, and techniques for solving them;
- acquire safe working habits and a positive attitude towards the safety of others;
- acquire knowledge about employment and further training opportunities in the custodial services field.

Suggestions for Teachers

The skill and knowledge that students develop in Senior Division courses in custodial services should relate closely to the commercial practices of local business and industry. The proficiency acquired in Intermediate Division courses can be further developed. Graduating students should be able to accomplish custodial tasks confidently, independently, and to appropriate standards.

Topics listed as core content for Intermediate Division courses may be treated again, at greater depth, in the Senior Division. Core content may be augmented by topics listed at the end of this module or in any other, related subject grouping of Part B. Curriculum content appropriate to course themes based on local occupational opportunities may also be included as required.

Simple maintenance activities normally identified with janitorial or custodial occupations (e.g., plumbing, glass cleaning, lighting maintenance, floor sealing, tilesetting, grounds maintenance) can be treated as separate trade themes. Where school-related packages can be arranged, students planning to enter custodial service occupations will benefit from a combination of service-oriented courses in the related mechanics, construction, and horticulture trade areas.

Every effort should be made to integrate the students' academic work with the tasks performed in the custodial services course. Ratios (used in mixing chemical cleaners or pesticides) and linear measurement (used when producing simple floor plans) are the types of mathematical principles that should be dealt with. The greater the degree of integration between the students' academic and shop work, the easier it is for them to understand and appreciate the relevant theoretical principles.

For some of the specialized themes that may be taught in Senior Division courses, the "learn, use, teach" cycle can provide a useful strategy. The student first learns a skill under the close supervision of the teacher. During the use phase, the student applies the skill independently. The teach phase then requires the student to demonstrate the skill to another person. Initially, the teach phase requires close support from the teacher to be effective.

The introduction of basic scheduling procedures for various tasks can provide the student with an insight into workloads and a sense of responsibility for the maintenance of part of a building.

Within a building, a variety of problems can develop that require action by a custodian. It is important for the teacher to discuss with the students such problems as broken windows, fires, flooding, excessive heating or cooling, and operation of the sprinkler system. In some cases the custodian can resolve the problem, but in other situations the problem will require a specialist. Students should be taught the emergency measures that should be taken.

Both indoor and outdoor pesticides should be discussed. Where, when, and how they should be used and the safety precautions and regulations that relate to their use should be taught.

The Grade 12 course should be oriented towards successful work experience. Ideally, students taking the custodial services program should be in co-operative education courses that involve up to half of their school time, so that they can obtain some functional vocational competence before graduation. Periodic review exercises to consolidate essential background knowledge are often of assistance to the student who is seeking entry into employment. In addition, themes related to building management concerns (e.g., comparing the costs and effectiveness of products and methods, using time effectively, and developing good interpersonal relations with clients, supervisors, and other workers) are conducive to successful work experience. Additional diploma credit may be built into these Senior Division courses for planned out-of-school work components within the co-operative education guidelines.

Painting and Decorating
Intermediate Division (Grades 9 and 10)

Painting and decorating is a worldwide industry and one of the oldest known. Courses offered in the Intermediate Division will provide students with opportunities to explore the types of skill and knowledge associated with preparing surfaces and applying various material coverings. As well, these courses can assist students in developing aesthetic perception and pride in the quality of their work.

Courses in painting and decorating are authorized for Grades 9 and 10 at basic and general levels of difficulty. Chart 2.1.10 identifies the core content for these levels. The aims and suggestions for designing courses at these levels are provided in the sections that follow the chart.

The amount of in-school time allotted for Intermediate Division courses in this subject may vary, depending on local requirements, from a minimum of approximately 55 hours over a two-year period to a maximum of 220 hours per year. If only the minimum time is available, then some of the core content will necessarily be given superficial treatment. It is suggested that fuller treatment be given to those core items related to safety; basics for painting; and preparation, priming, and finishing.

Chart 2.1.10
Core Content for Painting and Decorating
Intermediate Division (Grades 9 and 10)

Content Units	Core Content for Courses	
	Basic	*General*
1. Introduction	bcdf	bcdefgh
2. Safety	adgijk	adgijk
3. Project management		ae
23. Finishing		abc
40. Basics for painting	a	ab
42. Preparation, priming, and finishing	b	b
44. Weathering and surface deterioration		a
45. Wall coverings		a

See ''Course Content for the Construction Grouping'', beginning on page 52, for description of the subunits a, b, c, etc.

Basic Level

Course codes assigned to basic level courses planned under this section will be TCD1B for Grade 9 and TCD2B for Grade 10.

Aims

In all courses based on this section, students will have the opportunity to:

- develop a positive attitude towards safe work habits;
- develop the skills necessary to use properly the tools, materials, and climbing equipment involved in the painting and decorating trade;
- improve the communication skills required to function in the various occupations related to the painting and decorating trade;
- develop the skills and attitudes necessary to work co-operatively with peers and supervisors;
- develop the ability to systematically plan the steps necessary to complete a decorating task;

– acquire a sense of satisfaction in completing work tasks properly;
– acquire knowledge of the careers and further training opportunities available in the painting and decorating field.

Suggestions for Teachers

Courses in painting and decorating offered in Grade 9 at the basic level of difficulty should introduce students to the skills of these trades through simple activities and projects that they can complete successfully. The difficulty of the skill or activity that is introduced should increase steadily at a rate that challenges the student but that still allows for success. Math studies should be repeatedly reinforced through problems associated with the mixing, estimating, and costing of the materials needed for projects.

Small-group activities and projects should become a part of the students' experience soon after the basic skills are learned. Out-of-school projects in the community can be a valuable component of the course work in Grade 10. Group activities provide good opportunities for working on course objectives related to the attitudinal aims such as safety awareness and the ability to work co-operatively.

Courses in painting and decorating can provide students with the opportunity to develop skills and knowledge that they can use in decorating their own homes or apartments. Some students will become skilful enough to take on part-time painting jobs.

If time permits, the course may expand into other interesting areas, such as furniture refinishing or sign painting. Frequently, charitable organizations require large banners with the name of the association printed on them. This type of project provides the students with the opportunity to learn some basic skills in sign painting while producing a useful item.

Refinishing a piece of furniture brought from home can be great fun and should be encouraged once the students have developed sufficient skills to do it efficiently. At the Intermediate level, it is wise not to allow the students to bring in a very large piece of furniture; instead, they might work on a footstool or small chair.

Students must learn to take the time to properly prepare the surface they are about to decorate. They must understand that unless the surface is clean and free of blemishes, the finished product will never have a professional appearance.

It is also important to develop an appreciation for a clean, neat site while performing a task. The importance of using drop sheets and cleaning up the site and equipment after the task is completed must be stressed.

The students should be taught to assemble at least a single-tier scaffold and to appreciate the importance of securing it properly. Both extension and step ladders are in frequent use by painting and decorating tradespeople, so students need to understand when and where to use each type.

As students become involved in the various work tasks associated with painting and decorating, they should develop an increasing awareness of hazards that can develop at the worksite. In addition to developing safe work habits, students should be motivated to take remedial action in order to maintain a safe environment. Worksites should never be left in a condition that is not safe for others. Attitudes towards safety awareness that students develop in these courses should carry over into all of their other activities.

General Level

Course codes assigned to general level courses planned under this section will be TCD1G for Grade 9 and TCD2G for Grade 10.

Aims

In all courses based on this section, students will have the opportunity to:

- develop skills in the application of materials to various types of surfaces, using tools and equipment appropriate to the trade;
- master and apply safe work methods and procedures in the performance of tasks associated with the trade;
- identify and investigate scientific concepts related to the manufacture, nature, and application of materials used in the painting trade;
- solve problems, develop alternative solutions, and make choices related to the trade;
- develop pride in the results of their painting and decorating and confidence in their ability to work responsibly on their own;
- acquire knowledge of the careers and further training opportunities in painting and decorating.

Suggestions for Teachers

General level courses in painting and decorating for Grades 9 and 10 should cover the core content faster than basic level courses do.

Subunits from four additional units (''Project management'', ''Finishing'', ''Weathering and surface deterioration'', and ''Wall coverings'') are included in the core content for general level courses.

The topics in unit 1 of the core content can be effectively presented in informal discussions at various times during the course.

General shop safety (unit 2) and the responsibility of every student to maintain it should be discussed at the beginning of the course. Students should also be made aware of the roles of the Construction Safety Association and the Industrial Accident Prevention Association in maintaining safety on the job. Safety rules related to specific operations, equipment, and environmental situations should be introduced when the appropriate circumstances arise.

The content in unit 3 (''Project management'') deals with reading a simple architectural drawing for estimating purposes. Where it can be arranged, the teacher may cover this content in co-operation with the drafting teacher, who can offer a related blueprint-reading course.

Units 23 (''Finishing''), 40 (''Basics for painting''), and 42 (''Preparation, priming, and finishing'') involve preparing the surface for application of a finish. Students should have the opportunity to prepare a variety of sample pieces of material and to apply various types of finishes. Some samples may have an existing finish that must be removed before a new finish can be applied.

Weathering and surface deterioration (unit 44) is an important topic involving chemical reactions. These could be discussed with the students in their science program.

Students in the general level program are taught basic skills involving wall coverings (unit 45). Everyone in the class should have the opportunity to strip paper off a surface, prepare the wall for resurfacing, and apply a new surface.

If time permits, students at the general level should have a chance to become involved in sign painting (unit 41). Students should be allowed to use their imaginations in the design of these optional projects.

Small-group activities and community projects should be planned for Grade 10 general level courses. These activities may involve optional topics from the course content for the construction grouping, listed at the end of this module.

Painting and Decorating
Senior Division (Grades 11 and 12)

Courses offered in the Senior Division will focus on the skills and knowledge associated with the regulated construction trade of painter (commercial/residential and industrial). Students will perform interior and exterior work on a variety of surfaces and learn to apply a wide range of coverings to surfaces. Courses will aim at not only the acquisition of hand skills but also the development of aesthetic perception and pride in one's work. Students specializing in this subject field will gain insights into the broad field of construction and knowledge of the related employment opportunities in painting and decorating.

Some students may wish to specialize in the art of sign painting. This is an area that offers a wide range of vocational opportunities. The skills and knowledge developed at the high school level can be further developed at a community college.

Courses in painting and decorating are authorized for Grades 11 and 12 at basic and general levels of difficulty. Chart 2.1.11 identifies the core content for these levels. The aims and suggestions for designing courses at these levels are provided in the sections that follow the chart.

The courses may vary in time allotment and may be designed to offer credit for up to 330 hours of in-school work each year.

Chart 2.1.11
Core Content for Painting and Decorating
Senior Division (Grades 11 and 12)

Content Units	Core Content for Courses	
	Basic	*General*
1. Introduction	bcdefgh	bcdefgh
2. Safety	adgijk	adgijk
3. Project management	e	ae
23. Finishing	abc	abcd
40. Basics for painting	ab	abc
41. Sign and poster making	a	abc
42. Preparation, priming, and finishing	ab	ab
43. Interior and exterior decorating	a	ab
44. Weathering and surface deterioration	ab	abc
45. Wall coverings	a	ab

See "Course Content for the Construction Grouping", beginning on page 52, for description of the subunits a, b, c, etc.

Basic Level

Course codes assigned to basic level courses planned under this section will be TCD3B for Grade 11 and TCD4B for Grade 12.

Aims

In all courses based on this section, students will have the opportunity to:

- solve problems, develop alternative solutions, and make choices relative to painting and decorating activities;
- become skilled in applying materials to a variety of surfaces using equipment and tools appropriate to the trade;
- develop pride in the quality of their painting and decorating and confidence in their ability to work responsibly on their own;

- identify and investigate scientific concepts related to the manufacture, nature, and application of materials used in the painting trade;
- acquire knowledge of the employment opportunities in and the training and entry requirements for specialized occupations associated with the painting and decorating trade and the construction industry in general.

Suggestions for Teachers

Courses offered in Grades 11 and 12 at the basic level of difficulty will treat at greater depth the core content covered in the Intermediate Division. Subunits from six additional units are included in the core content for basic courses in the Senior Division.

The topics in unit 1 (''Introduction'') provide background information about the trade and can be reinforced and further developed in informal discussions at various times during the course. It is important for the teacher to discuss with the students the various career opportunities in this trade. Teachers should bring in a variety of tradespeople during the year and allow the students to discuss with them the advantages and disadvantages of their trades. Students should also be made aware of the advantages and disadvantages of self-employment. Work experience and co-operative education are excellent ways for students to determine which occupational path they would like to pursue. These two forms of out-of-school activities also provide students with valuable opportunities to practise the skills they have been introduced to in school.

The topics in unit 2, ''Safety'', must be dealt with continually throughout the program. Certain jobs in painting and decorating can be dangerous if safety precautions are not carefully observed. The proper handling and storage of chemicals and flammable solutions must be carefully and thoroughly taught. Students should also be made aware of the roles of the Construction Safety Association and the Industrial Accident Prevention Association in maintaining safety on the job. Safety rules related to specific operations, equipment, and environmental situations should be introduced only when the appropriate circumstances arise. Students in the Senior Division should be encouraged to recognize hazardous situations on the job and motivated to remedy them.

Students interested in entering a painting and decorating trade should be able to estimate with confidence the amount of material required to cover a surface. Students should also learn how to determine the cost of completing the task. Frequently, estimates must be made from a set of architectural drawings and specifications. Students should acquire some understanding of architectural blueprint reading so that they can acquire dimensions from a drawing for estimating purposes. Problems related to costing of materials and estimation of overall job costs should require students to apply mathematical and simple business principles.

The skills and knowledge outlined in the topics of units 23 (''Finishing''), 40 (''Basics for painting''), and 42 (''Preparation, priming, and finishing'') should be reinforced and further enhanced in each of the projects that students undertake in their Senior Division courses. These topics identify the fundamental skills and knowledge that students require to enter the painter trade.

The content of unit 43 (''Interior and exterior decorating'') introduces students to colour, light, and a wide range of other factors that determine the overall visual effect in an area that is being decorated. Teachers can effectively demonstrate some of the finer points of decorating by showing the students slides of good and poor decorating schemes.

In Senior Division courses, all students should acquire skills in wallpapering (unit 45). Students highly interested in this area should have opportunities to spend extra time on projects involving this type of work.

Senior Division courses should prepare students to progress steadily from group projects in school and in the community to work experience and on-the-job training with an employer.

General Level

Course codes assigned to general level courses planned under this section will be TCD3G for Grade 11 and TCD4G for Grade 12.

Aims

In all courses based on this section, students will have the opportunity to:

- develop skills in the application of materials to various types of surfaces, using tools and equipment appropriate to the trade;
- master and apply safely the methods and procedures of the trade;
- identify and investigate scientific concepts related to the manufacture, nature, and application of materials used in the painting trade;
- solve problems, develop alternative solutions, and make choices related to the trade;
- develop pride in the quality of their painting and decorating and confidence in their ability to work responsibly on their own;
- acquire knowledge of the employment opportunities in and the training and entry requirements for the other specialized occupations associated with the painting and decorating trade and the construction industry in general.

Suggestions for Teachers

Teachers planning courses at the general level of difficulty should review the suggestions for teachers in the preceding section for basic level courses. Many of those suggestions can be adapted to the planning of general level courses in this subject.

Core content that is covered in both Intermediate and Senior Divisions should be treated at greater depth in Senior Division courses. Activities planned around this content can reinforce the Intermediate Division work and support the more sophisticated objectives of Senior Division courses.

At the general level, content related to the science of paint technology, such as colour and adhesion, should be reinforced in the students' science courses if possible.

Mathematics can be reviewed in applications such as the costing of project materials and the development of estimates for larger jobs in the community. The latter activity can also give students practice in applying some simple business principles used by self-employed workers.

In discussions of general shop safety and the responsibility of students to maintain it, students should be made aware of the roles of the Construction Safety Association and the Industrial Accident Prevention Association in maintaining safety on the job. Safety rules related to specific operations, equipment, and environmental situations should be introduced or reinforced when the appropriate circumstances arise.

Sign and poster making (unit 41) can offer a wide range of very interesting and challenging activities. Projects can range from a sign or poster to be used in the school to a sophisticated neon display. The opportunities for employment in this field are diverse. Students who show interest and have some artistic talents should be encouraged to undertake challenging projects.

Students may be introduced to a variety of special finishing effects such as graining, gilding, marbleizing, and antiquing. Small pieces of various types of materials should be used when developing these skills. Eventually the students may apply one or more of these effects in a functional project.

Students studying at the general level of difficulty should be made aware of the opportunities in the field of interior design and the availability of further training and education

at a community college. To familiarize students with this field, a major theme on design, involving topics from the graphics and possibly the textiles grouping, should be considered.

Students should have the opportunity to visit trade shows to see the latest materials and techniques being used. Wallpaper and paint manufacturers often have excellent display rooms that can be visited on request. In some cases, demonstrations of the application of a new material can be arranged.

When students have developed a reasonably high level of proficiency in decorating, the teacher may arrange to have groups of two or three take on a job in the community. Senior citizens or a family with limited financial means may have a room they would like decorated. Students who undertake such projects should be involved in the planning and designing of the job, the estimating of materials, and all the work required to see the project through to completion.

Work experience and co-operative education should be a significant component of the Grade 12 course. Wherever possible, such experience should be scheduled as suggested in the guidelines for co-operative education. This combination of in-school and out-of-school learning can provide students with a good perspective on career opportunities in this field. Visits by tradespeople and contractors who are familiar with this aspect of the construction industry can also provide students with useful career insights.

Summary of Core Content for Courses in the Construction Grouping

Chart 2.1.12

Content Units	Woodwork (Grades 9-10)		Masonry and Trowel Trades (Grades 9-10)		(Grades 11-12)		Heating, Refrigeration, and Air Conditioning (Grades 9-10)		Plumbing and Pipefitting (Grades 9-10)	
	Basic	*Gen/Adv*	*Basic*	*General*	*Basic*	*General*	*Basic*	*Gen/Adv*	*Basic*	*General*
1. Introduction	ab	abde	abde	abdefh	abde	abdefh	abde	abdef	abcdeh	abcdefh
2. Safety	abi	abi	abcij	abcij	abcij	abcij	abdfgk	abdfgk	adgh	adgh
3. Project management	a	abc	ab	cde	a	ac	ad	abcd	ab	abc
4. Layout	ab	abc	b	abe	abe	abde	b	b	be	be
5. Woodworking trades materials	a	ab								
6. Trowel trades materials and processes			a	abc	abcd	abcd				
7. Building services materials							b	b	a	a
8. Foundations	bce	bcde			abef	abef				
9. Floor and ceiling construction	e	abcefh			a	ach				
10. Wall construction	c	acd	e	e	ef	ef				
11. Roof construction	a	abf								
12. Wall and ceiling finishing		g	c	c	acd	acd				
13. Floor finishes		d			ab	abc				
14. Stairs										
15. Chimneys, fireplaces, and barbecues					a	a				
16. Concrete construction			a	a	ab	ab				
17. Basic brick- and blocklaying			a	a	ab	ab				
18. Insulating	a	ac					abce	abce	d	d
19. Truing rough lumber by hand	b	ab								
20. Truing rough lumber by machine	ace	abcdef								
21. Special machines	a	a			b	b			c	c
22. Joining and fastening wood	b	abd								
23. Finishing	a	ac								
24. The conditioning of air							ac	abc		
25. Heating and cooling calculations							a	ab		
26. Refrigeration							a	ab		
27. Refrigeration systems							a	a		
28. Charging a system								a		
29. Plumbing systems and fixtures									ab	ab
30. Drainage systems									a	ab
31. Venting									a	ab

Building and Equipment Maintenance				**Custodial Services**		**Painting and Decorating**			
(Grades 9-10)		**(Grades 11-12)**		**(Grades 9-10)**	**(Grades 11-12)**	**(Grades 9-10)**		**(Grades 11-12)**	
Basic	*General*	*Basic*	*General*	*Basic*	*Basic*	*Basic*	*General*	*Basic*	*General*
adeg	adefg	adefh	adefh	bcefg	bdfg	bcdf	bcdefgh	bcdefgh	bcdefgh
adgij	adgij	abdgij	abdgij	adgi	adgi	adgijk	adgijk	adgijk	adgijk
ad	ad	acd	acd	a	a		ae	e	ae
				g	bg				
							abc	abc	abcd
	b		cd						
a	a	a							
c		c							

Content Units	Woodwork (Grades 9-10)		Masonry and Trowel Trades (Grades 9-10)		(Grades 11-12)		Heating, Refrigeration, and Air Conditioning (Grades 9-10)		Plumbing and Pipefitting (Grades 9-10)	
	Basic	*Gen/Adv*	*Basic*	*General*	*Basic*	*General*	*Basic*	*Gen/Adv*	*Basic*	*General*
32. Cleaning processes										
33. Cleaning washrooms										
34. Window and glass cleaning and cutting										
35. Waste collection										
36. Furniture care										
37. General maintenance (equipment)										
38. General maintenance (custodial)										
39. Work and energy										
40. Basics for painting										
41. Sign and poster making										
42. Preparation, priming, and finishing										
43. Interior and exterior decorating										
44. Weathering and surface deterioration										
45. Wall coverings										
46. Quantity production										
47. Shop computers										
48. Pipe and tubing materials	a		a				a		a	
49. Physics of heat				a						
50. Fundamentals of electricity				a						
51. Testing and measuring				a						
52. Fire control										

See "Course Content for the Construction Grouping", beginning on page 52, for description of the subunits a, b, c, etc.

Building and Equipment Maintenance				**Custodial Services**		**Painting and Decorating**			
(Grades 9-10)		**(Grades 11-12)**		**(Grades 9-10)**	**(Grades 11-12)**	**(Grades 9-10)**		**(Grades 11-12)**	
Basic	*General*	*Basic*	*General*	*Basic*	*Basic*	*Basic*	*General*	*Basic*	*General*
ab	ab	abd	ab	a	abce				
				a					
				a	b				
				a	b				
		a							
a	a	c	b	d	d				
	cd	a			bc				
						a	ab	ab	abc
								a	abc
						b	b	ab	ab
								a	ab
							a	ab	abc
							a	a	ab
a	a								
		a	a						
a	a	a							

Course Content for the Construction Grouping

1. Introduction	a) Care of the shop; course outline; student responsibilities; b) description of trades; employment possibilities; union affiliations; apprenticeship requirements; c) physical requirements of trades (climbing, balancing, etc.); d) educational requirements; history of trades; e) identifying, using, and caring for tools; work schedules; f) employee-employer relations; workload; stock control; forms processing; basic shop practices; staff problems; routines; warehousing; property ownership and management security; applied English (writing reports, ordering materials); g) customer and interpersonal relations; h) licences; ethical practices.
2. Safety	a) Accident prevention and safe work habits in the shop and on the job site; basic first aid procedures; fire prevention and fire safety regulations; the roles of the Construction Safety Association and the Industrial Accident Prevention Association; b) safety requirements for the use of electrical power; development of a positive attitude towards safety; c) placing and piling materials; using a wheelbarrow properly; precautions required in excavating; d) using acids safely and properly; controlling flammable liquids; e) properly operating a forklift and/or a front-end loader; f) occupational health and safety legislation; precautions in the use and handling of refrigerants; g) hazards of exhaust fumes; control of gases; h) precautions in the use of cements and fluxes; i) lifting techniques; using and caring for hand and power tools; electrical precautions; j) scaffold building and loading; k) using pressurized gases and liquids safely; personal cleanliness (washing hands before eating); controlling toxic dust; modern safety clothing and equipment.

3. Project management	a) Reading and interpreting simple plans and specifications; b) basic quantity analysis and costing; c) designing and drawing plans for simple projects using appropriate design criteria and drafting techniques; interpreting and using local and national building codes, including the appropriate NHA, zoning, plumbing, heating, electrical, and air conditioning codes and standards; d) using service and parts catalogues and indexes; preventive maintenance schedules; e) financing and scheduling; storing materials; controlling inventory.
4. Layout	a) Procedures and techniques for transferring sizes and shapes from plans to project materials and systems; b) using tapes, rules, squares, levels, gauges, and other layout tools correctly; using appropriate measurement terms and systems, including metric; c) 3-4-5 and diagonal squaring; d) setting property, building, sewer, and other key lines of control; e) determining and setting elevation, grades, and slopes; f) constructing and using batterboards.
5. Woodworking trades materials	a) Standard sizes and grades of lumber and plywood; particle board and plywood; defects and blemishes in lumber and their effects on strength and appearance; kiln and air drying; b) plain sawing and quartersawing; c) structure and growth of trees; wood identification and cell structure; d) veneer types; manufacture and uses of plywood and veneer board; e) advantages and uses of various composition boards such as tentest, masonite, particle board, plastics, and plastic laminates; costing – lineal foot, square foot, board foot.
6. Trowel trades materials and processes	a) Mortar, concrete, and plaster mixes; water-cement ratio and the use of aggregates, clean water, and accurate and complete mixing procedures; storage of materials; block and brick types, sizes, manufacture, testing; bonding in brick, block, and stonework; b) types, purposes, and grades of aggregates; c) testing concrete; fire ratings;

	d) sizes and classifications of tile; stone types; sizes, weights, and properties of wall tiles, including ceramic and glass; adhesives and grouting materials (uses and application techniques); e) lathing materials and systems; plaster and drywall materials and systems; fire-retarding qualities of gypsum wallboard.
7. Building services materials	a) Sizes, lengths, uses, weights, and properties of steel, cast iron, lead, copper, and plastic pipes and tubing; cutting and joining techniques, including swaging, flaring, bending, soldering, brazing, threading, reaming, and joining with adhesives and mechanical and threaded fittings; b) properties of and safety precautions for using refrigerants; valves, clean-cuts, and all fittings for various pipe and tubing systems.
8. Foundations	a) Basic soil types; excavation methods and sizing for foundations and services; b) safety; c) checking levels, squaring, and constructing simple footing forms; d) types, sizes, and construction of simple footings (NHA standards); e) wall types, materials, and sizes (NHA standards); form construction; waterproofing (including drain tile types and systems, parging, drainage gravel, tile beds, and waterproofing membrane); f) reinforcing concrete foundation units – materials and techniques; determining access and positioning for drains, sewers, and wiring; g) installing window and door frames; h) treated wood foundations; material estimates.
9. Floor and ceiling construction	a) Basic floor types, including concrete, to suit masonry and wood-frame systems; forming and reinforcing concrete floors; b) sill types; anchoring techniques; c) columns, beams, and girders – sizes, spacing, and installation (NHA and safety standards); d) materials, sizes, and spacing of floor joists (NHA standards); e) bridging – types, purposes, positioning, and installation; rough openings – sizes, positioning, and framing techniques (NHA and safety standards);

	f) ceiling construction similarities with floors; g) material estimates; h) construction techniques for entry and passage of services through floor framing and concrete; use of gyproc and metal lath; suspended system; repair work, including preparation, repairing, and finishing techniques.
10. Wall construction	a) Platform – balloon, braced, and post-and-beam framing systems; wall plates – stud positions and sizes; corners and wall intersections (NHA standards); rough-opening sizing and construction techniques; bracing types – their advantages and disadvantages; b) sheathing types (NHA standards); c) frame layout and assembly – squaring, plumbing, and bracing techniques; safety; d) material estimates; e) masonry systems (including solid, cavity, bearing, and non-bearing types); using brick, block, and tile in appropriate combinations and bonding styles; f) lintel and sill construction, including sizes when using wood, steel, and concrete (NHA standards); mortar joint sizes and finishing allowances for plumbing, heating, and electrical services; repair work and finishing techniques; g) methods of insulating; h) door buck and metal frame positioning, plumbing, and bracing; allowances, construction techniques, and adaptations for heating, electrical lines, ducts, and insulation.
11. Roof construction	a) Assembly procedures, rafter installation, and use of collar ties and gable end studs; safety; b) framing terminology (*rise, run, span, pitch, line length, ridge, overhang, birdsmouth,* etc.); material sizes and rafter spacing (NHA standards); common rafter – layout by step-off or line length, including basic calculations and use of the framing square rafter tables; c) advantages of flat, shed gable, and hip or cottage styles; d) sheathing techniques using boards and sheet goods; chimney and vent allowances; types and installation of asphalt shingles, ridge caps, and flashing for chimneys and vents (NHA and safety standards);

	e) roof trusses – types and advantages of each; f) material estimates.
12. Wall and ceiling finishing	a) Drywall systems, including cutting, fitting, fastening, taping, and finishing; acoustical plastering; stucco; special finishes; b) lath and plaster systems, including lathing installation techniques, grounds, beads cornerite, scratching, featheredging, straightening, two- and three-coat work, beams, arises; ornamental bench work using templates, running moulds, mitring, sticking, and planting; ornamental plastering – layout, templates, moulds, screeds, arches, niches, columns, cornices; casting, including mould treatments; repairing and finishing damaged areas; c) tiling systems and installation procedures; layout procedures; plumbing, levelling, and straightening techniques; d) brick and masonry veneer and facing systems, including pattern bonds and structural bonds; e) panelling systems, including basic strapping layout and installation, panel fitting, and fastening techniques; f) door- and window-frame installation procedures; g) trimming styles and techniques for doors, windows, baseboards, and cornices; siding – advantages of and installation procedures for various types of horizontal and vertical siding, wood, metal, shakes, and sheet goods.
13. Floor finishes	a) Screeding, compacting, and hardening procedures for concretes; styles and techniques for various trowelled and float finishes; b) special finishes, including non-slip; c) terrazzo finishing – preparation of base, grounds and beads, design and proportions for topping, grinding techniques; d) wood flooring – types and installation procedures; material estimates; e) sheet goods – tile and carpet types, layout, and installation; f) repair methods for damaged areas in all types of floor finishes; g) maintenance of wood, tile, terrazzo, concrete, carpet, and other floor types; care of sheet goods, carpets, and static floors.

14. Stairs	a) Basic stair construction, details and parts; standard sizes, calculations; handrails, safety concepts; forms for concrete stairs.
15. Chimneys, fireplaces, and barbecues	a) Types of chimneys – flue liners, hardware, fume problems; prefabricated and built-up fireplace styles – roughing in, hardware, brick and stone designs, finishing, draft-control systems; barbecue design and construction – proximity to house, interior barbecue problems, and fume control.
16. Concrete construction	a) Proper techniques for measuring, mixing, and pouring concrete in various strengths and positions; using and applying key additives; effects of temperature and moisture on curing; curing methods, including special agents; repair work and finishing techniques; b) uses and purposes of the varieties of concrete, including normal, high early strength, and watertight; frost control; types and construction of forms for basic concrete units, including slabs, footing, columns, walls, and beams; form release agents and techniques; safety; basic reinforcing needs and techniques.
17. Basic brick- and blocklaying	a) Basic tools, pointing mortar joints; glossary and trade terms; using lines, levels, and story rods appropriately; spreading mortar; laying brick and block; building corners; bonds; cutting bricks and blocks; using and installing special courses and anchors; control joints; b) estimating bricks, blocks, stones, and mortar.
18. Insulating	a) Insulation types and installation techniques; b) R factors, heat loss, heat gain; relative advantages of rock wool, fibreglass, vermiculite, rigid and poured foam systems; c) vapour barriers – types, positions, and installation procedures; d) insulating water pipes; e) heating and cooling ducts.
19. Truing rough lumber by hand	a) Calculating rough size required; selecting material – type of wood, blemishes and defects; b) order of surface finishing for truing stock; using various layout tools – squares, rules, straight edges, gauges; selecting and using appropriate saws for crosscuts or ripping;

	selecting and using appropriate hand planes to achieve flat, smooth, and square surfaces; checking accurately for flatness, square, straight, and parallel.
20. Truing rough lumber by machine	a) Order of surface finishing; selecting machines and machine allowances for working; crosscutting on a radial arm saw – safety, hand positions, stop blocks; using the jointer to machine a flat surface and a square edge – safety, use of push blocks, hand positions, guards, size of cut, limitations on size of material, grain direction; b) adjustment and special operations on the jointer – bevels, tapers, etc.; c) using thickness planer to machine lumber to correct thickness – safety, size of cut, adjustments, maximum and minimum sizes, grain direction; d) special operations on the thickness planer, including tapering, planing thin stock, planing short stock, using jigs; e) using a variety saw to cut to width – safety, hand positions, proper use of guard and push sticks, blade height, fence; crosscutting – mitre gauge, hand positions; f) special operations on the variety saw, including bevel, dado, tenons.
21. Special machines	*Note: The following machines and any others that the teacher considers appropriate should be used to complete special operations as required for student projects. In all cases, the proper procedure for the required operation should be taught, with a strong emphasis on safety.* a) Portable jigsaws and circular saws; band saws and jigsaws; hollow chisel mortiser; drill press; portable sander; disc, belt, and spindle sanders; lathe; shaper and portable router; b) power trowels; masonry saws; c) threading machines.
22. Joining and fastening wood	a) Types, purposes, and advantages of various types of glues and clamps; b) layout cutting and fitting mortise and tenon, dowel, dado, rabbet, edge-to-edge, lap, mitre, and other wood joints; types, sizes, and uses of nails; positioning of nails and number required; driving techniques; wood screws – types, sizes, installation procedures; screwdriver types – advantages, uses;

	c) clamps – design and construction of special jigs and clamping devices; d) miscellaneous hardware (bolts, lag screws, expansion shields, cabinet locks, pulls, hinges, catches, toggle bolts).
23. Finishing	a) General sanding and clean-up techniques; types, grades, advantages of various abrasive papers and materials; colouring wood; types of stain, paints, and fillers – their uses and application; sealing procedures using shellac, lacquer, and other sealers; protecting the surface – varnish, lacquer, oil finishes; French polish; solvent types for various finishing materials; choosing, caring for, and using brushes; b) using paint and varnish remover to strip off old finishes; c) smoothing and polishing with various rubbing compounds and materials; d) refinishing furniture (antiques); e) liquid and paste waxes.
24. The conditioning of air	a) Definitions and purposes of heating and cooling systems; air conditioning units – their construction and operating principles; types of distribution, purification, and humidification systems; b) history of heating; heating methods – hot water, steam, electric, solar; fuels – gas, oil, coal, electricity; c) air circulation; types of conditioning – heating, cooling, humidity, filtering; air filters – types, efficiency, applications, installations, maintenance (cleaning, oiling), and records; d) distribution systems; heating methods – gas/oil furnace construction and operation; comparison of types of residential heating and/or cooling systems; ventilation; control systems and techniques; humidity – control techniques; solar technology and alternative energy studies; basic types, application, control, and maintenance of pumps, compressors, and heating and air conditioning equipment.
25. Heating and cooling calculations	a) Heat loss/gain; heat flow; insulations; R factors; effects of windows and doors; b) calculation of residential cooling and heating loads; dry- and wet-bulb temperatures; relative humidity; dew point; air velocity; psychometric chart; comfort temperatures; heat transfer.

26. Refrigeration	a) Definition, properties, and measurements of heat; sensible and latent heat; effects of pressure on a gas; effects of heat on a body; changes in state and volume; temperature – description and measurement; b) Boyle's, Charles's, and Dalton's laws.
27. Refrigeration systems	a) Component parts and their functions; open, semihermetic and hermetic, rotary, and centrifugal units; application of refrigeration systems – domestic, commercial, and industrial; b) maintenance and repair of systems; compression systems; fluid flow; vaporization; basic electrical circuitry applicable to refrigeration systems, including all control systems; manifolds and gauges.
28. Charging a system	a) Proper techniques of evacuation and charging; leak-detection methods; gauge manifold – installing gauges, measuring pressure; vacuum pumps; purpose, types, and properties of refrigerants; safe handling of refrigerants.
29. Plumbing systems and fixtures	a) General knowledge of hot- and cold-water supply; operation of and simple repairs on valves, water closets (toilet bowl and tank); b) installing drains and waste lines; valves, water closets (toilet bowl and tank); water heaters; water softeners; c) sink and bath fixtures; washing machines; humidifiers; fountains; showers; types and purposes of basins, baths, drains, and other types of plumbing systems; cleaning and maintaining fountains, sinks, drains, water closets, urinals; germicidal cleaning of washrooms, showers, and sauna baths.
30. Drainage systems	a) Drainage systems – types, sizes, and purposes; locations and functions; health restrictions; b) drain plan; sanitary drains; storm drains; foundation drains; building traps; clean-outs; soil and waste stacks and stack footings; offsets; c) sewage disposal plants; septic tanks; drain clearing equipment; traps and vents.

31. Venting	a) Types, sizes, and purposes; syphonage; back pressure; importance of venting to health; b) advantages of continuous waste vent; fittings; height of branch connections; sizing; distance from trap inlet to vent; maximum grade; approved materials.
32. Cleaning processes	a) Types and applications of dusters, mops, brooms, brushes, abrasive pads, sweeping compounds; cleaning chemicals and their uses; dust control; damp and wet mopping; b) scrubbing and stripping floors; spray buffing; finishing floors; cleaning washrooms; cleaning glass; collecting waste; c) detergents and soaps, stripping chemicals, germicides; cleaning walls – methods for various types (wood, painted, block, ceramic); vacuum cleaning – methods (wet and dry) for different applications; cleaning drapes, floors, rugs, and furniture; d) chalkboards – types, break-in, cleaning methods; e) waxing methods and wax mixtures; cleaning compounds; using and caring for cleaning equipment; cleaning problems and their treatments.
33. Cleaning washrooms	a) Maintaining washroom areas – fountains, sinks, drains, toilets, urinals, showers, and saunas; germicides for walls, cubicles, floors, pool decks, and fixtures.
34. Window and glass cleaning and cutting	a) Types of glass; window and glass cleaning methods – chemicals, tools, inside and outside glass, high and low glass; b) glass-cutting tools and methods; glazing a window.
35. Waste collection	a) Garbage disposal systems – incinerators, compactors, outside waste removal; tools and equipment; b) cleaning and maintaining equipment; health and sanitary regulations.
36. Furniture care	a) Types of furniture – cloth-covered, metal, wood, painted; cleaning upholstery with chemicals; repairing furniture joints; refinishing and maintaining wood and metal; b) hanging pictures.

37. General maintenance (equipment)	a) Landscape maintenance – lawn mowers, sweepers, blowers; b) maintenance of mechanical systems – waste compacters, incinerators, fans, motors, lubricating systems; air compressors – types, applications, checking, blowdown, oil level, high pressure, low pressure; boilers – types, main parts, fuels, inspection requirements, log, blowdown, venting domestic water, thermostats, oil filters, safety valves, smoke indicators, expansion tanks, emergency routines; pumps – types, applications, checking, packing, lubricating, and maintaining; c) scaffolds – types, uses, erection, safety measures, safety equipment; d) maintenance of cleaning equipment and tools – vacuum cleaners, floor machines (mops, brushes, etc.); e) maintenance of swimming pools; mechanical maintenance – conveyors, hoists; bearings, seals; drives, clutches, and couplings; hydraulic and pneumatic systems; farm equipment (maintenance and repair).
38. General maintenance (custodial)	a) Preventive maintenance; establishing job routines; rug maintenance – cleaning (with vacuum, shampoo, steam, water, dry foam), testing for colourfast, testing for types of fabric, spotting, minor repairs; b) schedules and scheduling procedure; establishing job routines; flag rules; cutting grass; sweeping driveways and walkways; c) removing snow; d) lawns and gardens; ice control; parking lot markings, curbing; e) caring for and using vacuum cleaners (including wet-pick-up vacuums); repairing leaky taps, cleaning drains; adjusting door closers; caring for and using floor maintainers; waxing and polishing various floor surfaces; washing and cleaning venetian blinds; cleaning upholstery; supervising a building; parking lot marking; ongoing maintenance of outdoor recreational sport facilities (e.g., tennis courts) and driveways.
39. Work and energy	a) Measurement; input and output; the idea of efficiency; conservation of energy; the rate of doing work; solids, liquids, gases – density and pressure.

40. Basics for painting	a) Using materials, tools, and equipment; preparing surfaces; selecting and preparing coatings; application and drying times of various coatings; b) special coatings; c) types of spraying units – standard (compressed air), hydraulic (airless), electrostatic; spraying techniques.
41. Sign and poster making	a) Layout and basic sign painting; types and uses of sign writers' brushes; designing, cutting, and using stencils; b) sign writing on glass; using gold and silver leaf; c) types of lettering; using pens for posters.
42. Preparation, priming, and finishing	a) Treating concrete, stone, and metal surfaces; b) priming, undercoating, and finishing wood and plaster surfaces; treating interior and exterior wooden surfaces (new and previously painted).
43. Interior and exterior decorating	a) Aesthetics, colour theory, light theory, and shadow; the design elements; colour harmony and room finishes; absorptive qualities, moisture content, the moisture meter; pointing and stopping materials and methods; elementary co-ordination; b) mixing and matching colours.
44. Weathering and surface deterioration	a) Paint defects; identification of deterioration in surface finishes; resurfacing paint-coated surfaces; b) removing paint from old surfaces; c) corrosion treatment; heat effects on paint; causes of peeling, scaling, and blistering.
45. Wall coverings	a) Methods of stripping wallpaper; wallpapering techniques; types, design, and quality of wall coverings; calculating surface areas to be covered – rectangles, circles, triangles, cylinders; roll sizes – metric and imperial; b) special papers; special adhesives.
46. Quantity production	a) Designing and using jigs and fixtures for multiple cutting of duplicate parts.
47. Shop computers	a) Information storage and retrieval; remedial work and testing; inventory control; source of supplies; sequential planning of operations; job costing; recording amounts of materials used.

48. Pipe and tubing materials	a) Types, sizes, and applications of soft and hard copper and plastic tubing; methods of joining and forming; fittings for various pipe and tubing systems.
49. Physics of heat	a) Definition of heat; heat flow; heat transfer; convection, conduction, radiation; conversion of heat energy; insulation; temperature measurement.
50. Fundamentals of electricity	a) Function of electricity applied to a refrigeration system; electrical test instruments – use and application; interpreting an electrical circuit diagram (for a refrigeration system); lighting maintenance – types of lights (incandescent, fluorescent, sodium, mercury), lamp replacement, relighting an area; electrical fixtures – cleaning, repairing; electrical safety – turning off power and lockout, testing for power; fuse box, circuit breakers; grounding; overload; the duplex plug; the light switch; electrical connections; connection cords, cord plugs; table and floor lamp maintenance.
51. Testing and measuring	a) Pressure, temperature, electrical, and linear measurements – types of instruments and methods of application; detecting faults in a system.
52. Fire control	a) Classes of fires; extinguishers; equipment control; evacuation; fire alarms.

Appendix
Courses in Technological Studies (by Subject Grouping)

*Courses identified with this symbol will continue for the time being to be based in part on existing Senior Division guidelines, such as the *Elements of Technology* series and particular Grade 11 and 12 outlines in *Technical Subjects RP-27, 1963*.

	Course	Div	Approved Course Levels			Course Code
1. Transportation Grouping	Automotive Mechanics	Int	Basic	General	Advanced	TAM
	Automotive Mechanics*	Sr	Basic	General	Advanced	TAM
	Auto Body Repair	Int	Basic	General		TAB
	Auto Body Repair*	Sr	Basic	General		TAB
	Small Engines	Int	Basic	General		TAE
	Small Engines*	Sr	Basic	General		TAE
	Service Station Attendant	Int	Basic			TAS
	Service Station Attendant	Sr	Basic			TAS
	Agricultural Equipment Servicing	Int	Basic	General		TAG
	Agricultural Equipment Servicing	Sr	Basic	General		TAG
2. Construction Grouping	Woodwork	Int	Basic	General	Advanced	TCW
	Construction Technology*	Sr	Basic	General	Advanced	TCY
	Carpentry*	Sr	Basic	General		TCC
	Industrial Woodwork*	Sr	Basic	General		TML
	Masonry and Trowel Trades	Int	Basic	General		TCT
	Masonry and Trowel Trades	Sr	Basic	General		TCT
	Heating, Refrigeration, and Air Conditioning	Int	Basic	General	Advanced	TCH
	Heating, Refrigeration, and Air Conditioning*	Sr	Basic	General	Advanced	TCH
	Plumbing and Pipefitting	Int	Basic	General		TCP
	Plumbing and Pipefitting*	Sr	Basic	General		TCP
	Building and Equipment Maintenance	Int	Basic	General		TCM
	Building and Equipment Maintenance	Sr	Basic	General		TCM
	Custodial Services	Int	Basic			TCS
	Custodial Services	Sr	Basic			TCS
	Painting and Decorating	Int	Basic	General		TCD
	Painting and Decorating	Sr	Basic	General		TCD

	Course	Div	Approved Course Levels			Course Code
3. Electrical Grouping	Applied Electricity	Int	Basic	General	Advanced	TEA
	Electrical Technology*	Sr	Basic	General	Advanced	TEY
	Electronics	Int		General	Advanced	TEL
	Electronics*	Sr		General	Advanced	TEL
	Electrical Appliance Repair	Int	Basic	General		TER
	Electrical Appliance Repair	Sr	Basic	General		TER
	Computer Technology*	Sr		General	Advanced	TEC
4. Food Services Grouping	Baking	Int	Basic	General		TFB
	Baking	Sr	Basic	General		TFB
	Food Preparation – Commercial	Int	Basic	General		TFC
	Food Preparation – Commercial	Sr	Basic	General		TFC
	Food Preparation – Domestic	Int	Basic	General		TFD
	Food Preparation – Domestic	Sr	Basic	General		TFD
	Restaurant Services	Int	Basic	General		TFR
	Restaurant Services	Sr	Basic	General		TFR
5. Graphics Grouping	Drafting	Int	Basic	General	Advanced	TDR
	Drafting – Architectural*	Sr		General	Advanced	TDA
	Drafting – Electrical*	Sr		General	Advanced	TDE
	Drafting – Mechanical*	Sr		General	Advanced	TDM
	Drafting – Comprehensive*	Sr	Basic	General	Advanced	TDG
	Blueprint Reading and Sketching	Int	Basic	General	Advanced	TDB
	Blueprint Reading and Sketching	Sr	Basic	General	Advanced	TDB
	Graphic Communications	Int	Basic	General	Advanced	TGR
	Graphic Communications*	Sr	Basic	General	Advanced	TGR
	Photography	Int	Basic	General	Advanced	TGP
	Photography	Sr	Basic	General	Advanced	TGP
	Vocational Art*	Int	Basic	General	Advanced	TGV
	Vocational Art*	Sr	Basic	General	Advanced	TGV

	Course	Div	Approved Course Levels			Course Code
6. Horticulture Grouping	General Horticulture	Int	Basic	General	Advanced	THO
	General Horticulture	Sr	Basic	General	Advanced	THO
	Landscape Design and Maintenance	Int	Basic	General		THL
	Landscape Design and Maintenance	Sr	Basic	General		THL
	Nursery Production	Int	Basic	General		THN
	Nursery Production	Sr	Basic	General		THN
	Greenhouse Production	Int	Basic	General		THG
	Greenhouse Production	Sr	Basic	General		THG
	Floral Design	Int	Basic	General		THD
	Floral Design	Sr	Basic	General		THD
7. Materials, Processes, and Design Grouping	Industrial Arts, Grades 7 and 8	Int	—	—	—	—
	Industrial Arts, Grades 9 and 10	Int	Basic	General	Advanced	TIN
	Industrial Arts	Sr	Basic	General	Advanced	TIN
	Design Studies	Int	Basic	General	Advanced	TID
	Design Studies	Sr	Basic	General	Advanced	TID
	Elements of Technology*	Int	Basic	General	Advanced	TIE
	Elements of Technology*	Sr	Basic	General	Advanced	TIE
8. Manufacturing Grouping	Machine Shop Practice	Int	Basic	General	Advanced	TMS
	General Machinist*	Sr	Basic	General	Advanced	TMS
	Millwright*	Sr		General	Advanced	TMM
	Mechanical Technology*	Sr		General	Advanced	TMY
	Sheet Metal Practice	Int	Basic	General	Advanced	TMT
	Sheet Metal Practice*	Sr	Basic	General	Advanced	TMT
	Welding	Int	Basic	General		TMW
	Welding*	Sr	Basic	General		TMW
	Foundry Practice	Int	Basic	General		TMF
	Foundry Practice*	Sr	Basic	General		TMF
	Power Transmission and Control	Int		General	Advanced	TMC
	Industrial Control – Power and Processes*	Sr		General	Advanced	TMC
	Hydraulics and Pneumatics*	Sr		General	Advanced	TMH
	Instrumentation*	Sr		General	Advanced	TMI
	Principles of Technology*	Sr		General	Advanced	TMP

	Course	Div	Approved Course Levels		Course Code
9. Personal Services Grouping	Cosmetology	Int	Basic	General	TPC
	Cosmetology	Sr	Basic	General	TPC
	Guiding and Tourist Services	Int	Basic	General	TPG
	Guiding and Tourist Services	Sr	Basic	General	TPG
	Home Nursing, Child Care, and Health Care Services	Int	Basic	General	TPH
	Home Nursing, Child Care, and Health Care Services	Sr	Basic	General	TPH
10. Textiles Grouping	Sewing and Clothing Construction	Int	Basic	General	TXS
	Sewing and Clothing Construction	Sr	Basic	General	TXS
	Textile Maintenance and Servicing	Int	Basic	General	TXM
	Textile Maintenance and Servicing	Sr	Basic	General	TXM
	Upholstery	Int	Basic	General	TXU
	Upholstery	Sr	Basic	General	TXU

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Woodwork (Grades 9-12)
Masonry and Trowel Trades (Grades 9-12)
Heating, Refrigeration, and Air Conditioning (Grades 9-12)
Plumbing and Pipefitting (Grades 9-12)
Building and Equipment Maintenance (Grades 9-12)
Custodial Services (Grades 9-12)
Painting and Decorating (Grades 9-12)

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